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UNITED STATES DEPARTMENT OF AGRICULTURE

FOREST SERVICE

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FOREST RESEARCH  
ACTIVITIES

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FOREST MANAGEMENT  
RANGE MANAGEMENT  
FOREST PRODUCTS

FOREST ECONOMICS  
FOREST SURVEY  
FOREST INFLUENCES

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FOREST RESEARCH  
BI-MONTHLY REPORT  
December 1, 1939



FOREST RESEARCH

BI-MONTHLY REPORT

December 1, 1939.

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## GENERAL

### INDUSTRIAL RESEARCH IN THE UNITED STATES

Scientific Monthly, December 1939, P.586

A generation or two ago the word "science" became so highly respected that it was applied to all sorts of things, whether or not they had any relation to scientific work. Even athletes, such as boxers, who had certain characteristics were said to be scientific. More recently "research" has come to wear the purple. In our universities it is rolled unctuously on the tongues of those who have seen it only from afar. It is honored in industry, finance and government. There is no other pillar of fire to guide us out of the night.

For 30 years the center of gravity of scientific research has drifted from our universities toward our industries, and now the current is becoming strong toward governmental agencies. All these trends arouse reflections. At the moment, however, we may review the magnitude of industrial research.

In 1938 there were 1,769 industrial research laboratories in the United States employing about 30,000 persons. The estimated annual expenditure of these laboratories is \$100,000,000, with a wide margin of uncertainty. The chemical industries employ more scientists and pay more for research than any other industries, the electric and communication industries coming second. Together these two industries account for nearly half of industrial research.

Without any basis for comparison, the persons employed in industrial research and the expenditures for it appear enormous. But only about one percent of manufacturing corporations maintain research laboratories and only one sixth of one percent of the value of their products is spent for research. In a sense, research is a sort of insurance. Considered from that point of view, the expenditures for it seem extremely small. Enormously more is spent for fire and other insurance; enormously more is spent for insuring a continuing supply of raw materials. Much more is spent for accounting and legal advice. Much more is spent even in preparing for governmental agencies the numerous reports required of corporations.

F.R.M.

## Allegheny

Personnel. On October 15, Dr. Hardy L. Shirley of the Lake States Forest Experiment Station assumed the Directorship of the Allegheny Forest Experiment Station. Senior Economist Arthur Bevan was appointed Director of the Puerto Rican Forest Experiment Station; C. H. Stoddard, Jr. has been transferred to Central States Station; and William Mollenhauer Jr. has returned from the Central States Station.

Cooperation. The Station has taken an active part in the cooperative farm forestry committees for Maryland, New Jersey, and Pennsylvania. The Pennsylvania program, already submitted, recommends a study of markets and marketing practices and it is expected that the New Jersey plan will include a similar project.

The Interstate Commission on the Delaware River Basin (Incodel) has requested the National Resources Planning Board to make a study of the water resources of the Basin, similar to those already completed for the Red River of the North and upper Rio Grande. The request was referred to the Drainage Basin Committee, which recommended favorable action by the Board. Forbes, as Departmental representative on the Basin Committee, consulted other bureaus of the Department extensively, and submitted to the Committee a brief proposing a comprehensive program of short term studies in small tributaries illustrating common watershed covers. These will involve stream gauging, infiltration, snow and frost measurements, and interpretation of the results as the basis for appropriate action programs.

Mr. Benson Paul of the Forest Products Laboratory visited the Station to secure data on the problems of wood use encountered by the various wood-using industries, with particular reference to the quality of wood as influenced by growth rate or other features controllable through silviculture.

## California

New Products Chief. On October 25, Mr. L. N. Ericksen arrived at Berkeley to take over the conduct of Products research at this Station. He comes to the Station from the Western Pine Association, but was formerly at the Forest Products Laboratory.

## Central States

Meetings. Hall took the opportunity afforded by the "Itinerant Conference" of the Department to tour the entire route, starting in Columbus, October 9 and winding up ten days later in Ames. Results and Impressions: A much larger forestry task than most of the Department has visualized. Planning committees are retiring huge areas of

submarginal agricultural land to forest use, and the research task is very heavy in finding ways of restoring these lands to productivity.

Kellogg has been designated to clear and coordinate Farm Forestry Research Programs under the Norris-Doxey Act. He will act for the Director in all the preliminary stages of project development. During the past two months, meetings with agencies in Illinois, Iowa and Missouri have produced results. Ohio agencies are shaping up a research project which will give assistance to the Ohio Woodland Survey now in progress.

A conference of Ohio foresters was held for discussion of current reforestation problems in Ohio on October 18, 19 and 20. Representatives from the Ohio Division of Forestry, the Forest Service, and the Soil Conservation Service met for field tours and evening conferences. Auten, Chapman, Cummings and Kellogg participated.

Field tours were arranged to bring under review plantings exemplifying the problems of effective reforestation under the diverse old field conditions obtaining in Ohio. The group examined S.C.S. plantings that emphasized contrasts in the early development of planted trees on different soil types. Soil origin was held as important for the success of black locust plantings. A limited number of plantings of other hardwoods on soil recently denuded of forest cover were found to be developing satisfactorily. In looking over administrative plantings and experimental plantings on the Wayne Unit, the unsuitability of the majority of these sites for immediate reforestation with the better hardwood species, and the use of shortleaf and pitch pine for initial forest cover, was demonstrated.

The group also visited the Waterloo State Forest and Carbon-dale Coal Company plantings - among the oldest in the state. A diversity of species is represented - many exotics and some indigenous to southern Ohio. White pine - which occurs in natural stands in eastern and southeastern Ohio - in older plantations on suitable sites, is putting on good growth, and with marked crown class differentiation heavy thinning does not appear prerequisite to the establishment of white pine and hardwood reproduction. Comparable plantations of red pine show a marked showing up of terminal growth; have an even, dense canopy; and, without adequate thinning there is stagnation in diameter growth and little chance of natural reproduction. It was brought out that priority of use is involved in questions of plantation tendance. Thus, a planted pine stand that is maintained pure, dense canopied, with all stems pruned, and with a uniform pine litter forest floor, may have the greatest recreational use.

Evening seminars stressed the evolution of the planting programs, objectives, problems and methods. Edmund Secrest discussed the character of forest planting in Ohio as influenced by changing emphasis in objectives. In the initial plantings (shortly after 1900) of catalpa and a few other species, fence post crops were sought. Later, reforestation of old fields was emphasized. Recreational and aesthetic values became prominent more recently. As experience proved that the planting of valuable hardwood timber species was not generally feasible, certain conifers which survived and developed well on the poorer soils came into wider use. . . . W. S. Ligon presented observations on the development of black locust on different soil types without discussing reasons for apparent relationships. He had observed no cases where soils of limestone origin failed to support acceptable black locust growth; whereas, there were numerous examples of sandstone and shale soils with impervious lower horizons where locust had failed but pine was developing satisfactorily. . . . J. T. Auton displayed evidence that under sassafras developing on old field soils there is a progression toward characteristic mull forest soil, while under black locust the changes in physical character of old field soil are slower. . . . J. C. Craig's summary of fertilizing experiments with black locust described a planting in Indiana where the superiority in growth with increasing applications of fertilizer at time of planting has been maintained through several years."

Cooperation. The Ohio Woodland Survey, conducted by the Ohio Division of Forestry under a WPA grant, progresses with a survey of remaining woodlands in northeastern, central and southwestern Ohio. A meeting of the survey foresters and cooperating individuals was held at Columbus on Saturday, October 21. At that time, the first complete county report "Forest Resources of Preble County, Ohio" was presented. A pertinent paper on "The Place of Forestry in Geauga County Agriculture" was given by County Agent, Chas. A. Haas. Geauga County is in the center of the maple sugar and syrup region in northeastern Ohio.

On November 18, a second meeting was held at Ohio State University. A report on the "Forest Resources of Madison County, Ohio" was given. This county originally contained much prairie and was characterized by much bur oak. The statement was made that great defect occurs in the butt logs of the largest oldest timber in this county, attributable to early fires. On this class of logs, timber operators state that the cull for red oak is 50 percent, and for white and bur oaks is 65 percent. Grazing and overcutting are considered the greatest current problems. Lack of reproduction of all oaks is credited to rodent influence and grazing.

Research by a graduate student at Ohio State University disclosed superior development of pasture beneath black walnut and black locust trees on marginal land in southeastern Ohio. This finding is indicated by observation of tree crop plantings on property of the Muskingum Conservancy District surrounding Senecaville Reservoir. Many species of foreign chestnut and propagated varieties of black walnut, pecan, persimmon, black locust and other promising strains of several species were used. Part of the stock was purchased and part of it obtained from the tree crops nursery of T.V.A.

#### Lake States

Meetings. Zon and Moser attended meetings of the Northern Great Lakes Regional Committee at Madison in October and December. The purpose of the meetings was to seek agreement on a legislative program to put into effect the recommendations of the committee as set forth in its report to the National Resources Committee last summer. Forest rehabilitation is considered one of the important problems in the program for bringing back prosperity to the northern part of the Lake States.

#### Northern Rocky Mountain

First Aid. As a representative of the station, Rapraeger attended a first aid training course held under the auspices of the American National Red Cross. This winter, as a part of the training program of the station, he will instruct the field-going men on the proper procedures in first aid. Rapraeger was quite enthusiastic about the course and considers it one of the best events he ever attended.

## FOREST ECONOMICS

### FOREST SURVEY

#### Appalachian

Girard spent the latter part of November in the Mountain Unit of North Carolina collecting information regarding the quality and accessibility of the hardwood timber in this unit. His findings will form the basis for breaking down the board-foot volumes obtained in the inventory by log grades and will give a much clearer picture of timber conditions in this important area.

The 1937 Census of Lumber Production in North Carolina, made in cooperation with the Bureau of the Census, worked out very satisfactorily and much duplication of effort was obviated. The Bureau of the Census obtained a much more accurate estimate of lumber production than would have been procured by the usual methods, and the Survey has the information needed to keep drain figures up to date.

It is interesting to note that the 1938 Census of Lumber Production, recently released by the Bureau of the Census, shows that North Carolina has more sawmills than any other state in the Union and that it ranks first in the South and fourth in the United States in lumber production. In 1936 North Carolina ranked seventh in the South and eleventh in the country. This change in rank in three years is probably due to a more complete record of lumber production for the state through Survey assistance, rather than to any major change in the rate of production.

Computations of growth and drain have been completed for the Coastal and Piedmont Units of North Carolina. The preliminary balance sheets indicate that net growth exceeds the cut in the coastal plains by a substantial margin, but that the drain in the Piedmont Unit is considerably in excess of net growth.

#### Lake States

Census of Wisconsin Sawmills, 1938. The comparative value of standing timber, logs, and lumber by species and the proportion of the various species cut in Wisconsin during 1938 as obtained by the Station in cooperation with the Census is shown in the following table.

Wisconsin lumber production, by species and estimated value of product -- 1938

Species	Percent cut	Value of lumber per M ft.b.m.	Value of logs used for lumber per M ft.b.m.	Value of standing timber per M ft.b.m.
		<u>Dollars</u>	<u>Dollars</u>	<u>Dollars</u>
Softwoods				
Pine.....	11.5	29.08	19.74	7.41
Spruce.....	0.3	24.55	19.93	8.25
Balsam.....	0.1	20.16	.....	.....
Tamarack.....	0.2	22.58	16.71	8.37
Hemlock.....	32.1	22.61	13.99	6.60
Cedar.....	0.4	15.75	14.00	5.86
Total.....	44.6	24.06	15.68	6.94
Hardwoods				
Maple.....	18.8	29.91	22.20	6.38
Birch.....	12.6	35.24	21.97	7.65
Beech.....	0.2	25.51	15.00	2.00
Basswood.....	6.2	34.99	20.34	10.02
Elm.....	4.3	27.65	18.50	9.57
Oak.....	9.2	25.75	19.15	4.86
Aspen.....	3.0	18.94	7.72	2.60
Miscellaneous..	1.1	26.44	19.48	6.50
Total.....	55.4	30.62	21.19	7.08
All species.....	100.0	27.37	19.87	7.03

Northern Rocky Mountain

Honeywell and Conn remapped the areas in Sanders and Mineral Counties that were logged or burned since 1937 when the first survey mapping in these counties was completed. This brings the survey maps in these counties up to December 31, 1939.

Field work on stocking correlation studies was completed in Lincoln, Sanders, Mineral, and Ravalli Counties under the direction of crew leaders Hawk and Brown. An analysis of these studies will provide a correlation of the stocking classification based on the stocked quadrat method using 4-milacre units, with normal standards.

Kemp analyzed the 865 stocking correlation plots taken in pole and seedling and sapling stands of white pine in northern Idaho. The results are presented in the following tabulation:

Comparison of average<sup>1/</sup> actual and normal stocking  
in white pine stands in northern Idaho

Survey stocking class 1/	Age class	Trees per acre	Normality percentage	
			Tree basis	Basal area basis
	<u>Years</u>	<u>Trees</u>	<u>Percent</u> <sup>2/</sup>	<u>Percent</u> <sup>2/</sup>
Well )	1-20	1,070	17	86
Medium )		355	6	23
Poor )		98	1	9
Well )	21-40	1,096	29	74
Medium )		459	12	19
Poor )		100	3	6
Well )	41-60	878	45	78
Medium )		421	20	49
Poor )		100	2	4

1/ All averages weighted for site.

2/ Based on an average age of 20 years for the 1-20 year class, and a median age for the remaining age classes.

The effect of precocious trees and probably the presence of trees older than the main stand account for the wide discrepancy between the stocking percent based on number of trees as compared to the stocking percent based on basal area. This is most striking in the youngest age class even though the mean age was assumed to be 20 years.

The data clearly indicate that a stocking standard based on 13.2-foot quadrats is too low for white pine stands younger than 60 years and that the size of the quadrat should be varied according to age if a uniform stocking classification is desired.

### Pacific Northwest

Special project assignments considerably altered the fall program. One special project called for a detailed analysis of the forest resources of an area of 250,000 acres. This involved revision in the field of the inventory and office analysis of type and volume data and correlation with economic data such as tax delinquency. Field work on this project was completed in November. Another new project being undertaken is the revision of the economic availability classification



for the Douglas fir region. Analysis of the forest resources in the proposed Cascade Ridge National Park was undertaken to supply information to a special committee formed by the Washington State Planning Council.

#### Douglas Fir Region

As a result of a special project the inventory revision of Lewis County, Washington, was commenced in the field during October. Despite the size of this county, which has an area of  $1\frac{1}{2}$  million acres and a total timber stand of around 35 billion board feet, and the lateness of the season, excellent progress is being made in the field. Four men are now in the field and work will be completed by the middle of December.

Reinventory of Snohomish County shows that in the past six years saw-timber volume declined from 16.7 billion board feet to 15.5 billion board feet. As usual the privately owned timber suffered most of the depletion, dropping from 5.4 billion board feet to 4.4 billion board feet. Old-growth Douglas fir declined from 3.1 billion board feet to 2.5 billion board feet. It is significant to note that the volume of saw timber owned by the county increased slightly and the area of county-owned forest land more than doubled.

Restocking of cut-over lands is entirely unsatisfactory in this county. Out of 115 thousand acres cut before 1920 and non-stocked in 1933, only about 16 thousand acres had restocked by 1938. More than offsetting this was the addition to the nonstocked class of 53 thousand acres cut between 1920 and 1930.

#### Ponderosa Pine Region

The inventory, depletion, and growth sections of the regional report were revised in accordance with suggestions made after a preliminary review at the station.

#### Southern

General. The preparation of four state reports, the preparation, checking, and editing of unit reports, and preparation of two articles for publication, were the important items occupying the attention of Survey during October and November.

Eldredge prepared an article "New Forests of the Old South," for publication in the 1939 Christmas Issue of the Southern Lumberman. Stover prepared an article, entitled "Our Southern Forests," for publication in the November issue of the Southern Pulp and Paper Journal.

Wheeler spent October 30 to November 7 in Washington consulting Bureau of Census lumber production records for 1938 for states in the lower South, and discussed other drain and Survey problems with Garver and others in Washington. Wheeler then went to the Central States Station, Columbus, Ohio, for three days where he reviewed field data from the Illinois Farm Woodlot study, and assisted Worthington with outlines of procedures.

Forest Resources of Southeast Alabama. Southeast Alabama, one of the oldest agricultural areas of the South, has recently been faced with the fact that cotton, its principal cash crop, no longer can be depended upon to give adequate economic support to the area. According to this Forest Survey report, new industries are urgently needed to consume the timber that can be grown on the 4-1/4 million acres of forest land in the area. The report emphasizes that 56 percent of the forest area is in farm woodland and that sustained attention of the agriculturalists toward these areas should bring about direct remunerative returns to the owners.

The forest inventory of the Survey indicated that in 1935 there were almost 10 million board feet (lumber tally) of saw-timber material, most of which was second growth. In the pine and pine-hardwood types, more than three-fourths of the volume was in saw-timber stands having 2,000 board feet or more per acre. Considering all usable material, both saw timber and non-saw timber, in trees 5 inches d.b.h. and larger, the inventory was over 54 million cords of which 22 million were in pine, 18 million in soft-textured hardwoods, and 14 million in firm-textured hardwoods. The report points out the important fact that usable material in sound and rotten cull trees amounted to almost 9 million cords.

From January 1, 1935 to December 31, 1937, the volume of the growing stock in trees 5.0 inches d.b.h. and larger experienced a slight increase since growth exceeded drain. In 1937, the growth and drain for all species combined were almost equal; while pine showed a decrease, hardwoods increased. In 1937, however, the saw-timber component of the growing stock, all species combined, was reduced 12 million board feet because drain exceeded growth. If the mortality, however, had been reduced and the growth had been increased by fire protection and stand improvement cuttings, this loss could have been reduced or eliminated entirely. Thus, there is severe need for increased fire protection and good forest management practices which should have a prompt effect in increasing growth and improving the stocking of the forest stands. If proper management is given the forests, the forest industries in southeast Alabama could be expanded and additional employment furnished. Any expansion of the uses of forest raw materials, however, must be adjusted to the expected growth, plus the salvageable material in cull trees, thinnings, and that saved through the reduction of fire losses.

## FOREST TAXATION AND INSURANCE

### Pacific Northwest

Taxation. A chapter entitled "Local Government and Taxation Problems Bearing on Land Use" was rewritten for inclusion in the northern Sierra Nevada foothill land use report of the California Forest and Range Experiment Station and the Giannini Foundation of Agricultural Economics.

Local government adaption studies in Stevens County, Washington show that the 80 active school districts in this county could be replaced by 12 districts with 12 school establishments with pupil transportation time and distances still conforming to State standards.

There is a great deal of local interest at this time in the subject of Federal contributions in lieu of taxes on Federal lands. The Portland Chamber of Commerce and the Association of Oregon Counties have had active committees studying the reporting on this subject.

### Southern

In the tax-index project, final tabulations of data on average tax per acre on forest land bearing various types and conditions of timber, or clear-cut, in Marion, Newton, and Alcorn Counties, Miss., have been made. Field work will be resumed in Quitman County, Miss., about December 11, and Craig plans to complete Holmes and Wilkinson Counties, Miss., during January.

## NEW PUBLIC DOMAIN

### Pacific Northwest

Cooperation. Cooperation continued with the Pacific Northwest Regional Planning Commission, the Bureau of Agricultural Economics, and Washington State College, and respectively consisted of collaboration in preparation of a report upon migration and economic opportunities in this region, with particular attention to phases dealing with rural land uses; of work on regulatory measures in general and

Southern

Craig attended, as Station representative, the four-day conference at Vicksburg, Miss., called by the Bureau of Agricultural Economics to develop the program for the inter-bureau land and social economic survey of the Yazoo Backwater Area in Mississippi. This area of about one million acres is being studied by the Department of Agriculture in relation to possible changes in land use and socio-economic structure required by the now completed, presently contemplated, and possible future flood-control programs. The Forest Service has a vital stake in this area, about 65 percent of which is now forest land, and within which the Delta Purchase Unit of the Mississippi National Forests is located.

## PRIVATE FORESTRY

Allegheny

Anthracite Survey. Mesavage has prepared a tentative working plan for the newly established anthracite region forest study. The tentative plan designates Luzerne County, Pennsylvania, as representative of the anthracite region. In this county it is planned to select a representative small area, perhaps one township, for detailed study on an intensive scale. The entire county will be covered to secure data on an extensive basis, and this information will subsequently be related to the anthracite region as a whole.

Central StatesFarm Woodlands

The sample tree data from the Illinois Woodland Survey were mailed to Washington for placing on punch cards. P. R. Wheeler, in charge of computations for the Southern Forest Survey, spent a few days at the Station outlining tabulating machine procedure throughout for comparison with the hand process of placing the strip tally data in shape for constructing stand structure diagrams by forest site-types and condition.

Some preliminary steps in the pasture analysis were outlined for execution under the Station's WPA project.

Southern

As a member of the Station's Farm Forestry Committee, Craig attended a three-day conference at Stillwater and Oklahoma City, Oklahoma with representatives of the Prairie States Forestry Project, Lake States Station, Soil Conservation Service, the Oklahoma Agricultural Experiment Station, and Oklahoma Extension Service, at which the research section of the State Farm Forestry plan was extensively revised and finally approved. Specific projects were delineated and are now being drafted for submission to Washington.

## RANGE ECONOMICS

Intermountain

Seasonal Range Use Relationships on a National Forest and a Grazing District. In a study of the relation of grazing on the public lands in an area consisting of seven counties in south-central Utah, the movement of livestock from the private lands to the public lands has been mapped "in place" for all of the livestock enterprises. This shows, for the medium and large-size sheep operations, a high degree of association in the use of range on the Fishlake National Forest and Utah Grazing District No. 3, the "West Desert" district (consisting of Millard and Beaver Counties) which lies just west of the Fishlake National Forest.

This relationship may be seen by comparing figures 1 and 2, showing the seasonal grazing load on the Fishlake National Forest and Utah Grazing District No. 3. These graphs show that May and October are the intervening months in the movement of sheep between these two types of public land. Note the extent of the sheep use of the grazing district during April, and of the forest during June. Few of these sheep operations do any winter feeding, and lack of adapted spring range has led to this unseasonal use of both winter and summer range.

There is little, if any, association of these two seasonal ranges in use by cattle. The cattle that use the Fishlake National Forest are maintained on hay and pasture during the winter months. Approximately three-fourths of the cattle use on the grazing district is yearlong use. The extent of spring and summer use by cattle of the desert ranges shown by figure 2 is considered undesirable. The summer use by cattle will no doubt eventually be confined, by adequate fencing and riding, to allotments on the higher ranges.

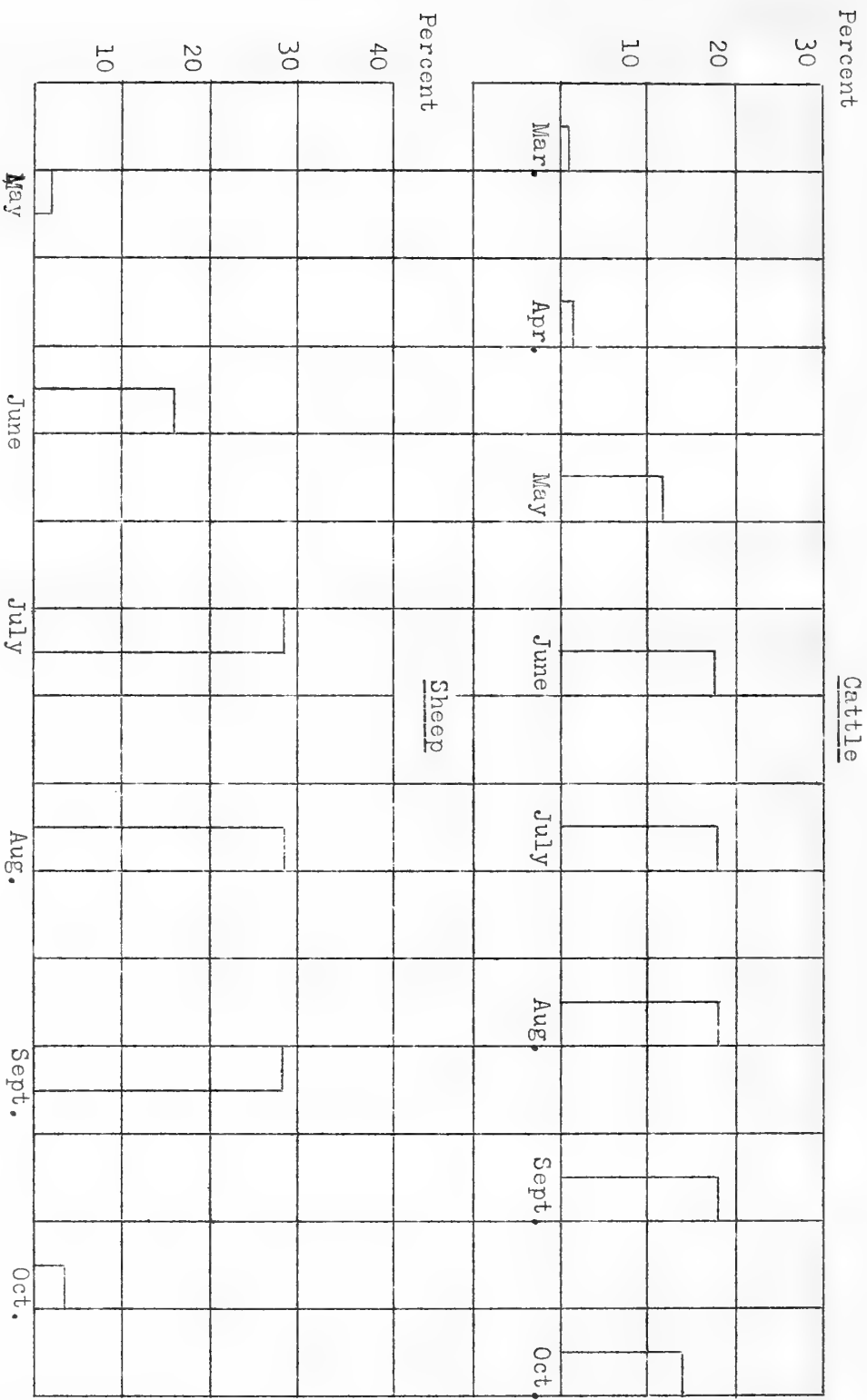
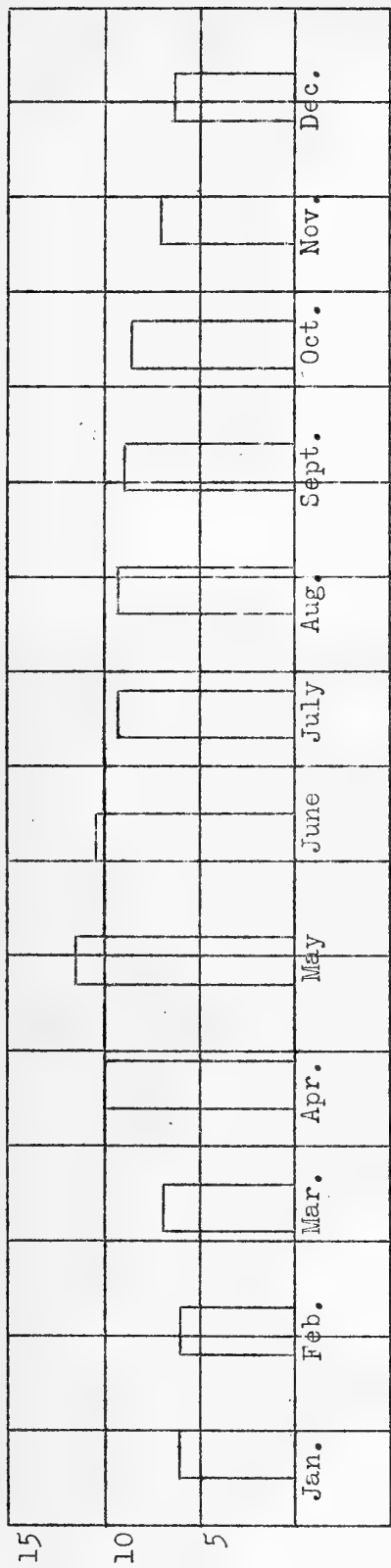


Figure 1. Percent of Permitted Months of Grazing in Each Month on the Fishlake National Forest, 1939

Percent

Cattle



Percent

Sheep

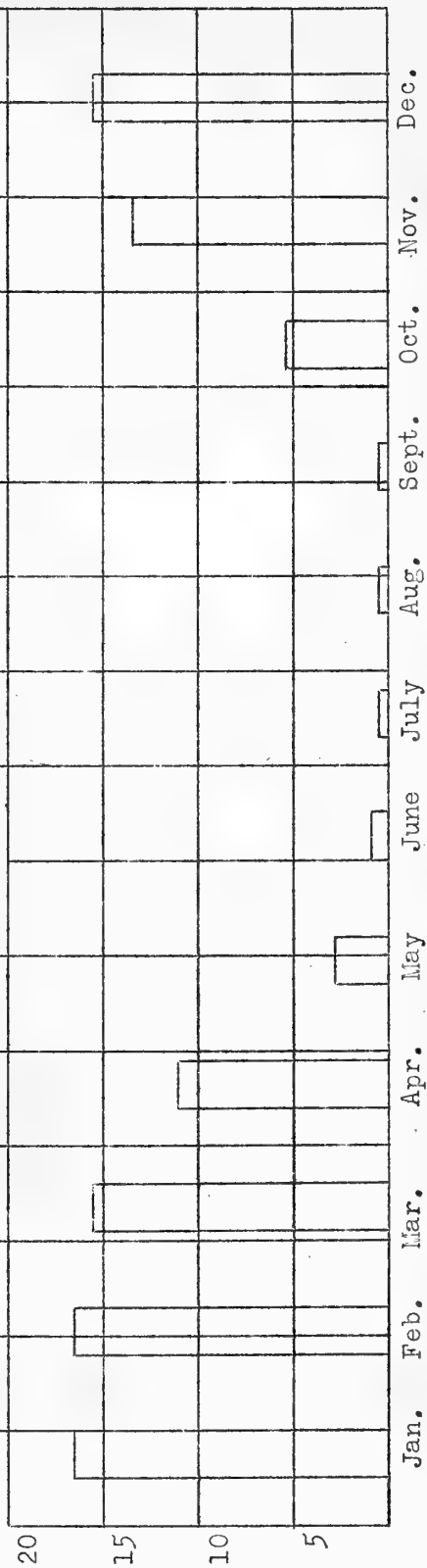


Figure 2. Percent of permitted months of grazing in each month on Utah No. 3 Grazing District, 1939-40.

## FOREST MANAGEMENT RESEARCH

### FOREST FIRE PROTECTION

#### Allogheny

##### Behavior

All the fire weather records taken at the Lebanon Experimental Forest during the past year have been checked. Data giving results of tests made on individual factors of the R-7 fire danger meter (amount of rainfall, indicator stick readings, etc.), and on the meter as a unit, have been partially summarized. The results indicate that the meter must be revised for application under New Jersey conditions.

##### Effects

The possibility of establishing CCC demonstration plots to test the effectiveness of annual controlled burning for 1 to 6 years in securing natural pine reproduction was discussed with Assistant State Foresters Moore and Waldron. Present studies on controlled burning in the oak-pine type are limited to evenaged mature stands. Last year CCC demonstration plots to test the effectiveness of mechanical treatments of the soil surface in preparing a seedbed for pine (and thus securing natural reproduction) were established in both evenaged and unevenaged stands. Since annual burning appears to be more effective than periodic burning at longer intervals, and that only three to six burns are necessary, and since the present controlled burning studies are designed to test periodical burning at intervals ranging from one to fifteen years, it would seem advisable to establish the proposed demonstration plots in an effort to obtain a more complete comparison of the effectiveness and costs of mechanical treatments and controlled burning. Such plots would be established in unevenaged stands -- presumably those having an oak understory approximately 25 to 30 years old. Thus by the time the treatments had been made and the establishment of pine reproduction secured, the oak would be at the proper age (40 years) to cut for cordwood.

#### Appalachian

Fire Danger Measurement. A study of fuel moisture and weather factors as influenced by altitude and aspect has been under way at this Station and has been reported on occasionally during the past year and



one-half. During mid-November, one of the worst fall fire periods in the southern Appalachians for several years, there was plenty of evidence of the significance of elevation and its effect on danger.

The following data were measured at similarly exposed stations, 500 vertical feet apart on a northwest-facing slope. The "low" station is near the base of the slope in the valley, the other about "middle" slope:

	November	<u>14</u>	<u>15</u>	<u>16</u>	<u>17</u>	<u>18</u>	<u>Mean</u>
		<u>Degrees F</u>					
Maximum temperature							
Low station		65	69	65	68	62	66
Middle station		60	64	62	66	61	63
Minimum temperature							
Low station		21	23	27	29	35	27
Middle station		41	43	47	48	50	45
		<u>Percent</u>					
Maximum relative humidity							
Low station		100	100	96	94	87	96
Middle station		32	35	33	32	33	33
Minimum relative humidity							
Low station		19	17	21	15	33	21
Middle station		23	21	24	17	27	22

An 18-degree difference in average minimum temperature for the period and 65-percent differences in night-time humidity certainly resulted in more favorable fuel moistures on the lower slopes and in the valleys. Unfortunately, we have not at present any mechanism for recording fuel moistures.

Fifty-nine danger stations are now being placed on Region 8 forests. That forest ratings can be compared, different meters used in major types must be checked for comparability. Jemison met with Bickford and Bruce of the Southern Station in Florida recently to initiate a field test of danger meters on southern national forests and to determine what adjustments should be made to bring the two present meters into line.

### California

Wind Velocities. For the past several summers at Pilgrim Creek Nursery on the Shasta Experimental Forest wind velocities have been measured at various heights above ground. This was done in three types of cover: grass, brush, and pine forest. Certain relatively simple and useful generalizations have been drawn. The wind velocity is found to be greatly reduced at all boundary surfaces such as the upper and lower limits of the forest canopy, the top of the brush,

and the grassy layer near the ground. The wind velocity is nearly constant within the canopy zones. The shapes of the vertical velocity distribution curves are different for each cover type and depend on the number of boundary zones present.

It has been a practice among foresters to consider the wind velocity in a pine forest to be 40 percent of that above the trees. Our study shows that the relation is not this simple. In general the percentage figure is not a constant. For midday conditions, when the air temperature decreases with height, the proportion of the wind velocity within the stand to that above the crowns is smaller, the greater the velocity above the crowns. Thus, for our forest conditions at Mt. Shasta, for a 5-mile an hour wind high above the trees, the wind blowing at the 6-foot level was 24 percent as strong, whereas for a 15-mile an hour wind above, the velocity at the 6-foot level was only 14 percent as great. The wind velocities at any two heights bear a linear relation to each other, but the linear slope and intercept are dependent on the temperature difference between the two levels and on the height of the lower level above the ground surface.

Smoke Visibility. The results of two years' work on the physical aspects of forest fire smoke visibility have been summarized in the form of a report entitled "Visibility of a smoke column." The phenomenon of the visibility of a forest fire smoke is almost wholly physical and, therefore, like a problem in physics, can be approached by theoretical analysis. Such analysis reveals the factors which must be measured in order to express smoke visibility in terms of the maximum distance at which a normal eye can just detect a smoke of given size and suspensoid density. These factors are: atmospheric haze, azimuth of the sun, background, brightness, illumination of the smoke and of the background, the quality or sootiness of the smoke, and the distance between the smoke and the background. The relation between the smoke visibility and these many independent variables is thus quite complicated. Hence it cannot be expected that the visual range can be estimated with much exactness from a measurement of the atmospheric haze alone, as is the present practice. The advantage of this theoretical analysis as a preliminary step to actual field study is that it limits the problem by establishing the pertinent variables and offers a working hypothesis to serve as a framework for the field experimentation.

Fire danger rating. The danger rating system, developed under the guidance of an administrative-research committee, has been firmly established on the national forests of California. Though there are many possibilities of further perfection through application of the results of current investigations, it is felt that the present system is basically sound and is a valuable aid to fire control. This coming year the system is being adopted by the California State Division of Forestry. Two meetings of state rangers have already been held for

the purpose of acquainting them with the system and its operation. Instruments for approximately 100 new stations have been ordered and Herman Meyer, Assistant Ranger from the State Forester's office has been selected to supervise installation. Although members of the Experiment Station have participated in the meetings, principal credit for this worthy extension work is due to C. R. Tillotson of the Regional Forester's office. These many additional stations are expected to give valuable aid to fire weather forecasting.

An innovation not previously reported but worthy of note was begun last July. At that time the Fire Weather Division of the U. S. Weather Bureau began estimating experimentally for each danger rating area (4 to 14 per forest) the average fuel moisture and average wind velocity expected at 4:30 p.m. on the following day. To date only a partial summarization of the predicted and actual values has been made but these experimental specific estimates were considered by the Fire Weather Service to be successful. It was found that 85-90 percent of the fuel moisture estimates were within 1 percent; 85-90 percent of the wind estimates within 4 miles per hour, and 75 percent of the wind estimates within 2 miles per hour. The importance and significance of this step will be evident at once to all familiar with danger rating systems, since with such estimates the probable fire danger rating at 4:30 p.m. tomorrow can be calculated.

Soil sterilization. During November, supervision was given the application of white arsenic around the poles of the Pacific Gas and Electric Company power line along the Merced River. The purpose of the arsenic is to sterilize the soil against annual vegetation. Grass, wild oats, and other species grow thick and rank in this Merced River district and are burned off each spring by the Stanislaus National Forest. In order to protect the poles from the fire, it has been the practice each year before burning to clear a circle of 6 to 8-foot radius around each pole. This is a costly and ever recurring manual task. At a cost for chemicals of about \$12, 192 poles were treated with 400 pounds of white arsenic. At this spreading rate, it may be reasonably expected that the growth of annual vegetation will be prevented for at least five years. This soil sterilization job is the result of the chemical experiments that have been conducted by the fire group of this Station for several years and is one of the first large scale sterilization projects undertaken by a national forest.

#### Northern Rocky Mountain

Fire Research. The entire scheme of fire danger measurement in Region One is to be recast this winter if time and the facts necessary are available. We now have the records for five consecutive seasons of measurement on 10 forests, and two seasons on 7

other forests as a basis for this recasting. If the several objectives of danger measurement can be clearly stated, a deliberate examination of the records available should show (1) those objectives that are attained by the present scheme; (2) what modifications can be made at once to better meet certain needs; and (3) on what specific features research in 1940 should be concentrated.

The present scale of fire danger, from 1.0 to 7.4, the present danger meter, and the present methods of measuring each of the factors used on the meter, originated in 1930-31, in what now appears to have been a simple and somewhat abstract desire for a system, any kind of a system, to guide and largely to replace undefinable estimates. By the close of the disastrous 1934 fire season almost any kind of a system looked like a life preserver worth grasping for, and as the danger measurements of 1934 appeared to have been justified by fire behavior and man-power needs, the model 4 danger meter was adopted for official use in 1935.

That was five years ago, and it would be a woeful admission to proceed as if we had not learned something about the other functions of danger measurement in that period. The recasting planned is therefore intended to capitalize on this experience. It could not have been done sooner, and it is entirely possible that we may not yet be ready to do a good job, because no instrument, method, or system can be properly judged until it has been tried conscientiously and thoroughly.

#### Pacific Northwest

The study of fire protection on private lands which was recommended by the Advisory Council was put under way at short notice and has been the chief activity. Several weeks were spent by Matthews and Morris in Snohomish County, Washington, the first unit to be studied, where they made a fuel type map and observed local conditions. The fire records of the county were copied. A working plan for the office work is now in preparation.

Matthews and Morris attended the Region 6 fire assistants' meeting and reported to them the progress made in the various fire studies, principally fire danger rating, fire control planning, and man-power production in fire fighting. The fire assistants seemed to be particularly interested in this last study, which indicates that the amount of effective fire control work decreases markedly as the size of the crew increases. For example, the summary of the field records obtained by observing crews in action on fires shows that the per man output of a 15-man crew is about twice the output of each man in a 60-man crew; or, stated in another way, two 15-man crews working separately should be just about as effective as one 60-man crew. The loss of efficiency

as the size of crew increases seems to be explained in part at least by the fact that nonproductive time spent in walking, resting, loafing, etc. is multiplied by the size of the crew without any offsetting advantages. The only apparent advantage of large crews is their ability to complete a given amount of work in a shorter time than a smaller crew. Therefore, in determining the ideal size of crew for any specific situation, consideration must be given to the total time available to do the job as well as to the output per man.

## Southern

### Control

A meeting was held in Lake City, Florida where representatives of Region 8 and the Appalachian and Southern Forest Experiment Stations discussed the installation of fire danger stations in the National Forests in the South. At the same meeting the Appalachian Meter and the Longleaf-Slash Meter were discussed to determine the possibility of developing a single meter for use in the South. Following the conference danger stations were established on each ranger district in the National Forests of the South. A total of 31 stations are to be used this winter of which 14 are using the Longleaf-Slash meter, 11 are using the type 7 meter and six are using both.

Bickford and Bruce visited the Ouachita, and assisted in the formulation of an administrative study to determine the value of lopping slash in terms of hazard reduction.

An alinement chart was prepared for use in dispatching men and equipment to fires when the rate of spread index is known and the time from discovery to arrival is estimated. It is proposed to test this or some similar chart on the Conecuh National Forest during the spring fire season of 1940.

### Effects

Personnel of fire project aided in the controlled burning of 1200 acres on the Vernon District of the Kisatchie on the night of September 26. The purpose of the burn was seedbed preparation and hazard reduction.

## FOREST GENETICS

### California

Pine Hybrids. Several hybrid trees of a cross between shortleaf and loblolly pines (P. echinata X P. taeda) were obtained from a small, 1-bag test made at the Institute of Forest Genetics in 1933. These trees, which are now five years old, are almost twice as large as the five-year-old natural progeny (wind-pollinated) of the seed-parent.

On the basis of observations to date, it appears altogether probable that, like the seed parent species, the hybrid has the capacity to sprout. Tests for capacity to sprout, as well as for ability to grow from cuttings will be made later. It is quite probable that, if the hybrid can be propagated from cuttings, it will become of some importance in silviculture.

Its cytological, taxonomical and morphological features will be subjected to intensive study in the near future.

Natural or artificial hybrids between these important southern species have not been reported.

Timing of Experimentation in Pines. Plant experimentation quite often requires precise timing. This is particularly true when special treatment is applied at some designated developmental stage in the ontogeny of the plant. If fertilization and its effects were to be observed in tobacco, for instance, it would first be necessary to learn that fertilization takes place 21 hours after pollination. The same reasoning is valid in the case of Pinus, and for this reason material has been gathered at two-week intervals throughout the year and examined to determine the stage of development. This schedule of developmental stages now serves as a guide for various projects such as the application of rapid temperature changes in an effort to alter the heritable characteristics of the trees. This season temperature change treatments were applied to conelets of ponderosa pine growing at an elevation of about 5,000 feet. These treatments were timed to coincide with the fertilization period as determined by fixations of the previous year and periodic micro-dissection of material this season, the fertilization period occurring from about July 18 to July 23, some fourteen months after pollination had been effected. In like manner the time of sporogenesis of the macro-gametophyte was found to be about the middle of September, ten months before fertilization. Other important stages in the life cycle of ponderosa pine have been determined for the year during which fixations were made. A variation of a few days is to be expected from season to season, but future plans can be made far ahead on the basis of past behavior and minor adjustments can be made as the weather dictates.

Vegetative Propagation. Grafting experiments with various pines have been continued and expanded. Pinus canariensis was successfully grafted on P. coulteri and on P. radiata. Pinus ponderosa was grafted on P. halepensis and on P. densiflora. Some integeneric grafts of conifers have been attempted. Because of similarity in stem anatomy (and especially because of absence of vessels) in conifers belonging to different genera, integeneric grafting in this group of plants appears to be more feasible than in broad-leaf trees (angiosperm).

### Northeastern

The collection of seed set to controlled breeding was completed during this period. In the red oak group most of the seed which had set to controlled pollinations in 1938 failed to mature. A fair quantity of seed was collected from controlled pollinations on Pinus made in the spring of 1938. Birch produced the largest quantity of seed to controlled breeding, but in this case the possibility of parthenocarp or parthenogenesis, or both, must be considered.

A test planting at the Oxford Nursery, Frye, Maine, of two hybrid poplar clones on sod, plowed land, and on circular scalps varying in diameter from 6" to 24" has definitely shown that even 24-inch scalps are hardly sufficient for successful planting in heavy sod.

The work on vegetative propagation has been partly summarized, and a technical note (No. 29) has been completed on "Clonal Variation in Rooting Response of Red Maple Cuttings."

Preliminary work on the possible occurrence of natural polyploid races in red maple has been completed. Although stomata counts indicate the possible existence of polyploid races in the northern portion of the range of this species, the regional distribution from which herbarium material was available at The New York Botanical Garden was not sufficient for conclusive proof.

## MENSURATION

### Allegheny

#### Stand Studies

Methods of applying the growth figures for the Worcester County, Maryland, loblolly pine sustained yield unit were outlined in cooperation with a representative of Region 7 and the Maryland State Department

of Forestry. Defect data have been obtained by the Region. Mortality for loblolly pine were obtained by the Station from permanent sample plot records but no hardwood records are available. A mortality study was attempted on both the inventory and growth surveys, but with poor success.

## Pacific Northwest

Permanent Growth Study Plots in Douglas Fir. During October the Willamette permanent sample plots 1, 2, and 3 (formerly the Cascade plots) were measured for the seventh time. Compilation of the recent measurements and report preparation was also completed. These are the oldest permanent growth plots in the Northwest, 30 growing seasons having elapsed since they were established in 1910 by Thornton T. Munger. In growing from 54 to 84 years of age on land of site quality II, the average volume per acre has increased from 33 thousand to 72 thousand board feet, Scribner rule, a periodic annual increment of 1,300 board feet per acre. This high growth rate has been maintained in spite of the inevitable mortality from windfall and bark beetles, which have, in 30 years, caused a per acre loss of 5,100 board feet. Although large wood volumes have been produced, this wood is poor in quality as judged by market standards in this region. Clear length was measured to average only 5.4 feet and it appears that little or no clear lumber will be produced during the stand's first century. Two articles summarizing findings from these plots have been prepared, one for The Timberman and one for the Service Bulletin.

A new growth plot in the 99-year-old Douglas fir on Panther Creek in the Wind River Experimental Forest was established as a supplement to plots established some years ago in this locality.

Computation of the 1939 remeasurements of seven growth study plots on the Columbia National Forest has also been completed.

Growth Estimates for Burns Working Circle. During the past month this section has prepared preliminary growth estimates for the principal forest types of the Burns Working Circle at the request of the Regional Office of Timber Management. This activity has again emphasized the urgency of perfecting the techniques of making growth estimates and mortality predictions in ponderosa pine stands.

Stand Improvement. During the initiation of CCC stand improvement projects on the Cholan, Mt. Baker, and Wenatchee National Forests in November, Kachin's time was devoted to training of supervisory personnel and workers by explanation and demonstration in the field of the objectives and most promising methods of stand improvement work. Examinations on the Deschutes and Willamette Forests led to the selection of areas suitable for treatment.



On the Panther Creek division at Wind River, seven permanent plots have been established in the area which was thinned last season through a sale of piling. Unfortunately, failure of the operator to complete this sale as yet made it impossible to complete the series of permanent plots which would have sampled the six types of marking there to be tried.

## Rocky Mountain

### Stand Studies

Five mortality strips, 1x80 chains in size, were established last year in recently cut stands of lodgepole pine to provide information on the amount and rate of mortality in selectively cut stands. An inspection at the close of the first year following cutting indicates that the heaviest losses are caused by wind, while Ips come second. Dendroctonus beetles and miscellaneous causes such as porcupines, suppression, rot and brush burning caused but few losses. The volume losses for the first year averaged 159 board feet per acre. The following table shows the distribution of mortality in number of trees by causes.

Plot	Total trees on plot	Trees lost, by cause				Total trees lost	Losses in volume	Trees lost
		Ips	Dendroctonus	Windfall	Misc.			
No.	No.	No.	No.	No.	No.	No.	Ft.BM.	Percent
1	2,194	1	--	--	--	1	0	0.05
2	1,853	50	2	42	14	108	1,856	5.83
3	1,268	--	--	202	--	202	2,735	15.93
4	1,292	1	--	--	1	2	28	0.15
5	1,322	11	--	163	2	176	1,759	13.31
Total	7,929	63	2	407	17	489		6.17

## Southern

The users of the analysis of variance are undoubtedly aware of the interpretational difficulty that is encountered if the contribution to error term from the various treatment comparisons are not homogeneous. This difficulty can sometimes be remedied by using a transformed variable. Whether a transformed variable is used or not, the problem is how or what test can be made to detect the lack of homogeneity. The references listed below deal with this problem.

Article 1 containing a discussion of the applicability of the  $L_1$  test and the  $X^2$  test developed by Bartlett is highly recommended to all interested in this problem. The arithmetic calculation for the  $L_1$  test is adequately presented by an example in 5. The discussion in 8 is not elementary but is related to the applicability of the  $L_1$  test. Article 6 provides a good illustration of the computation for Bartlett's  $X^2$  test. Irwin's article, 4, is complicated but is basic to the understanding of the components of error.

If transformations are to be used, articles 2 and 3 will be helpful. In 3 are presented some illustrations of how the error term can be broken up into parts applicable to particular comparisons.

1. Bishop, D. J., and  
U. S. Nair                      A note on certain methods of testing for the homogeneity of a set of estimated variances. Supplement to the Journal of the Royal Statistical Society, VI (1): 89-99. 1939.
2. Clark, Andrew, and  
Warren H. Leonard              The analysis of variance with special reference to data expressed as percentages. Journal of the American Society of Agronomy 31 (1): 55-56. Jan. 1939.
3. Cochran, W. G.                Some difficulties in the statistical analysis of replicated experiments. The Empire Journal of Experimental Agriculture VI (22). April 1938. 157-175.
4. Irwin, J. O.                   Independence of the constituent items in the analysis of variance. Supplement to the Journal of the Royal Statistical Society I (2): 236-252. 1934.
5. Naylor, P. P. N.               An investigation into the application of Neyman and Pearson's  $L_1$  test, with tables of percentage limits. Statistical Research Memoirs, Volume I, pages 38-51. June 1936.
6. Rider, Paul R.                An introduction to Modern Statistical Methods. Page 102.
7. Snedecor, George W.           Statistical Methods, first edition, Chapter X, page 196.
8. Wilks, S. S., and  
Catherine M. Thompson           The sampling distribution of the criterion  $\lambda_4$  when the hypothesis tested is not true. Biometrika XXIX, Parts I and II, June 1937.

## REGENERATION

### Appalachian

Species Adaptation in the Great Appalachian Valley. The first-year examination of the experimental plots in eastern Tennessee, planted in January and February, 1939, has been completed. The summer of 1939 has been exceptionally dry and mortality was considerably greater than for the favorable 1938 season.

Although the data have not yet been analyzed, it is apparent that northern white pine, yellow poplar, and shortleaf pine were damaged by the drought more than black walnut, northern red oak, and white ash. Walnut and oak were established by direct seeding. Early summer rains were sufficient and, when the peak of the drought struck in August and September, these species, probably attributable to a well established root system, were well able to survive. The same effect was noted in comparing 1938 and 1939 plantings of the same species (of transplants) growing side by side. The trees which already had a year in the field were apparently unaffected by the drought while current year trees showed marked effects, especially premature leaf fall.

As for the 1938 plantings, rodent damage was localized. In certain places it is so severe that direct seeding of oak is precluded. These places are always characterized by a very heavy cover of grass, mostly Andropogon.

### Central States

Frost heaving is responsible for a large part of the mortality of shortleaf pine planted in old fields or other open areas in the Missouri Ozarks during the fall planting season. The possibility of reducing frost heaving by planting at a 45° angle was suggested as a result of leads obtained from an administrative study conducted by the Mark Twain National Forest. The Station, in a program of CCC cooperation with the Mark Twain, is initiating a more elaborate study to check on these results. The amount of frost heaving, survival, and subsequent growth rate of the pine planted at 45° angles will be compared with other pine planted in a vertical position by standard methods.

### Nursery

The problems of nursery soil amendments should be closely scrutinized, especially as to over fertilizing. At least one nursery in the region has been found where such an amount of fertilizer has been added as to be lethal. There is no fixed rule

for fertilizing; each soil is a problem in itself. Rates of infiltration and evaporation often limit the amounts of soluble fertilizers which can be applied safely.

## Lake States

### Nursery

In order to obtain information on the effect of soil moisture level on the growth of various species of seedlings used in the Great Plains shelterbelt planting, an experiment was conducted at Denbigh, North Dakota, in which 75 recently germinated seedlings of each of six species were potted in 2-quart waxed paper containers and held at various levels of available moisture for about two months. The soil used was a Barnes very fine sandy loam with a moisture equivalent of 16.16 and a computed wilting coefficient of 8.78 percent. The three levels of soil moisture were as follows: Dry: 8 to 12 percent of total moisture; fresh: 12 to 16 percent; moist: 16 to 20 percent.

The experiment, which was run in sealed pots, does not of course simulate field conditions as closely as might be desirable, but still should give some indication of what trend might be expected under nursery conditions. The increase in growth for most species at the higher moisture contents is given in the table. In the case of Chinese elm and Russian olive, the differences between moisture groups by analysis of variance were statistically significant at the one percent level, for honey locust at the 5 percent level, and for green ash and caragana the differences had no statistical significance.

From the weight of the seedlings and from height, balance, and relative vigor of the trees, it was concluded that very poor growth is obtained where the moisture content is held consistently below three to four percent of available moisture, and that to obtain adequate growth the moisture content should be in the 4-8 and 8-12 percent range for a considerable part of the time. The results of the test lead to the belief that moisture content of the soil of the Great Plains nurseries must be watched closely, especially in drought years, if stock of adequate size is to be obtained in the allotted time. It appears that green ash, caragana, and honey locust did not respond as much to higher moisture levels as did Chinese elm and Russian olive. It may be of interest to state that cottonwood (from cuttings) has an even higher moisture requirement than the five species listed in the table and that these cuttings failed to root at all in the "dry" range and did best in the moist range. Because of the very small number of surviving trees of cottonwood, this species was omitted from the table.

The maximum amount of water transpired by any of the potted plants in a 12-hour period of daylight was by a rooted cottonwood seedling about 16 inches high. This plant used up to one-third of a pound of water in a single 12-hour period. This fact may explain to some extent why it is more difficult to obtain successful establishment of cottonwood in Great Plains shelterbelt planting than with most of the other broadleaf species.

Average total green weight of the seedlings in grams and length of top in inches

Species	Approximate range of available moisture					
	Dry 0-4 percent		Fresh 4-8 percent		Moist 8-12 percent	
	Weight	Top length	Weight	Top length	Weight	Top length
Chinese elm	0.6	3.9	1.7	6.8	3.7	9.3
Russian olive	0.4	1.9	1.2	5.4	1.8	6.9
Honey locust	0.9	7.7	1.1	8.7	1.5	10.6
Green ash	0.3	2.6	0.5	2.5	0.6	3.9
Caragana	0.3	2.4	0.3	1.7	0.4	2.4

### Northeastern

#### Planting

Dry-ice refrigeration of planting stock in transit was accomplished successfully last spring. The stock, both hardwoods and conifers, was shipped to New Haven from the nursery, held in cold storage (32-34° F) for three weeks, then shipped by truck to the Chenango Experimental Forest in New York. Refrigeration during the truck trans-shipping was accomplished by placing dry ice in a corrugated container on top of the crate and covering the crate and dry ice container with a plywood box of the type used for shipping phonographs. The stock withstood the shipping, which occurred on a rather warm day, without any evidences of injury, even though it had already broken dormancy. Dry ice seems to offer opportunity for refrigeration of stock in transit. Investigations should be made of the possible toxic effect of excessive carbon dioxide and provision made in shipping container design to avoid such conditions if toxic effects may develop.

### Northern Rocky Mountain

Poisoning Treatments for Rodent Control. One of the biggest problems in direct-seeding operations is the elimination of seed-eating rodents from the vicinity. In the past, many repellents and poisons have been tried in attempts to minimize rodent depredations, but none was very satisfactory. Recently, the Control Methods Laboratory of the Biological Survey developed a poisoning treatment for the control of mice and chipmunks on seeded areas which shows promise of being efficient.

The method consists of first prepoisoning the selected areas about one week before sowing with hulled sunflower seed treated with thallium sulfate (1 part of  $Tl_2SO_4$  to 100 parts of seed by weight). This bait is spread on the surface of the ground using one pound per acre. In addition to this prepoisoning treatment, the seed to be sown is coated with a poisonous mixture containing approximately 48 percent yellow dextrine, 34 percent plaster of Paris, 15 percent corn meal, and 3 percent strychnine alkaloid.

In the fall of 1938 these treatments were used by Schapmeyer on two areas which were sown with seed of western white pine in spots 8 feet apart with approximately 20 seeds per spot. Both areas were clear cut and broadcast burned about a month before sowing. One of these areas, a square plot of 50 acres, was located in the Kalispell Creek drainage in the Kaniksu National Forest on a flat bench having sandy loam soil. The presence of rodents on the area previous to the time of sowing was demonstrated by a catch of 21 mice and 5 chipmunks over a 4-day period using a trap line of 24 mouse traps which were baited and set daily. Examinations on 12 sample plots of 25 seed spots each showed that germination of one or more seeds occurred in 76 percent of the total number of spots and that one or more seedlings were alive in 69 percent of the spots at the end of the first growing season. The second area was a plot of 11 acres on a north-facing slope in the Deception Creek Experimental Forest. This plot is on a silt loam soil and is surrounded on all sides by green timber. No trap lines were run on this area, but the fact that rodents cleaned out practically all seed in unprotected spots in the previous year on a nearby plot is evidence of the presence of rodents in the vicinity before sowing. On this area, germination occurred in 88 percent of the spots and one or more seedlings were present in 85 percent of the spots at the end of the first growing season.

The seedling was done at a cost of \$7.83 per acre using CCC labor valued at \$1.50 per man-day. Included in this total are the costs of bait and labor for prepoisoning which was \$0.47 per acre and of materials and labor for coating the seed, which was \$1.00 per acre.

The results of these tests indicate that the method is both practical and economical. It should be emphasized, however, that the tests were made on recently burned sites which are favorable for seedling establishment. It remains to be seen how well the method will work on less favorable sites.

### Rocky Mountain

Influence of terracing on plantation survival. Certain areas in the central Rocky Mountain region have been terraced for erosion control before planting with forest trees. The effect on survival of the planted tree, of its position in relation to these terraces, has been studied for a ponderosa pine plantation on a terraced area in the San Isabel National Forest.

The terraces on this area were designed to hold back all run-off under maximum precipitation intensities. The depth of the terrace ditches varies from eighteen inches to three feet. The general exposure is WSW, and topographic positions vary from a wide bench at the lower end to a slope of 45 percent which leads to a broad ridge.

The area was first planted in 1936 and replanted in 1937 and 1938. Survival in 1939 was 68 percent for all trees planted in the broken ground at the upper end of the terrace excavation. Trees planted in the unbroken sod or sagebrush between the terraces showed only 28 percent survival. Best average survival, 56 percent, was on the steep west slope, which would normally represent the most severe site, because the terraces were spaced so close together that practically all trees were planted in the most favorable position. Lowest average survival, 21 percent, was on the flat bench, where the horizontal spacing between terraces generally exceeded 50 feet. The data indicate that a much better general survival would have been obtained if the area between the storage terraces had been contour furrowed. Planting trees in these furrows would probably have made the second or at least the third replanting unnecessary, while at present, after two replantings, the areas between the terraces are still unsatisfactorily stocked.

### Southwestern

Douglas Fir Seed Spots. Results of experiments in direct seeding conducted at the Cloudcroft Branch Station since 1932 have consistently indicated that satisfactory regeneration of Douglas fir, whether natural or artificial, is largely dependent on seed being covered with soil and complete or at least partial control of rodents.

In continuing experiments to determine the influence of these two factors, seed spots were sown to Douglas fir seed on three different cut-over areas in the fall of 1938. These areas differed with respect to degree of cutting, brush disposal, protection against grazing, and treatment for rodent control as follows:

- Area 1. Light selection cutting; all cull material removed and burned, brush piled and burned; area fenced and poisoned.
- Area 2. Light selection cutting; cull material and slash left on ground and not burned; area not fenced and heavily grazed by cattle; not poison treated for rodents.
- Area 3. Heavy selection cutting; most cull material removed at time of logging; brush mostly piled and burned; area fenced but not poisoned.

On each of these areas a plot 5 chains by 10 chains was laid out and subdivided into chain-square units, corners of the units being permanently marked with grade stakes. Around each stake and spaced 36 inches apart, two seed spots, one of which was prepared and the other not, were sown to Douglas fir seed at the rate of 10 seeds per spot. Treatment of the spots differed in that on the prepared spots litter and vegetation were first removed, soil dug up and slightly compacted and seed then sown and covered, whereas in the unprepared spots the seed was merely dropped on top of the undisturbed ground. The spots were examined at frequent intervals throughout the entire field season of 1939 so that an accurate record of not only total germination but also of mortality and causes of death might be obtained.

The results show:

1. That both germination and survival were much better in prepared than in unprepared spots.
2. That both germination and survival were best on the poisoned area, 1.
3. That, with the exception of the numbers of seedlings starting on unprepared spots, the results obtained on areas 2 and 3 were very nearly alike.

What the results of this experiment show especially is the importance of seedbed preparation and covering of seed. These findings are in accord with results of previous experiments in which seed was sown in prepared and unprepared spots that were protected with hardware cloth screens, thus eliminating the influence of rodents.<sup>1/</sup>



## SILVICULTURE

### Allegheny

Ecology and Silvics. Revision of the rough draft of a manuscript by Forbes and Hough on the ecology, silvics, and silviculture of the beech-birch-maple-hemlock forest on the Northern Allegheny Plateau is in progress following review by Shirley.

### Appalachian

Harvest Cuttings - Loblolly Pine. During the spring of 1930 a stand of loblolly pine on the coast of North Carolina was selectively cut. The principal aims were to remove sufficient volume to make logging profitable and to favor loblolly pine in the succeeding stands by leaving vigorous medium-sized pines to provide loblolly reproduction and a future cut. The intensity of cut ranged from 60 to 75 percent of the original volume.

The original stand was densely stocked, of old-field origin, more than 90 percent loblolly pine, and about 55 years of age.

During routine examinations of the residual stand, it was noted that mortality was high. Since no check area was established, there could be no definite assurance that the observed mortality could be wholly attributed to the removal of part of the stand.

The table below summarizes the mortality and growth for the 10-year period after cutting. For the average acre, 20 percent of the reserved volume representing 30 percent of the reserved trees was lost during the 10-year period. Although the annual mortality was 193 board feet per acre, the stand showed a net growth of 140 board feet per acre per year. Nevertheless, a growth of 1.4 percent per acre per year is low for the rapidly growing loblolly pine.

Mortality and growth per acre 10 years after  
a loblolly pine stand was selectively cut

Plot	Spring of 1930		Fall of 1939		Mortality		Annual growth		Net annual growth	
	Trees	Volume	Trees	Volume	Trees	Volume	Volume	Percent original stand	Volume	Percent original stand
	Number	Bd.ft.	Number	Bd.ft.	Number	Bd. ft.	Bd.ft.	Percent	Bd.ft.	Percent
Plot 1	150	9,429	99	11,530	51	2,135	213.5	2.3	210.1	2.2
Plot 2	69	5,570	43	6,378	26	1,252	125.2	2.2	80.8	1.4
Plot 3	107	14,880	79	16,358	28	2,289	228.9	1.5	147.8	1.0
Plot 4	78	9,560	59	10,778	19	2,036	203.6	2.1	121.8	1.3
Average	101	9,860	70	11,261	31	1,928	192.8	2.0	140.1	1.4

### California

Harvest cutting - Ponderosa pine. Blacks Mountain project field work was completed for the season by November 30, except for burning slash. Continued dry weather has made burning unsafe to date. About three million feet of logs were delivered to the purchaser. Two four-thousand foot-capacity Diamond-T trucks and Freuhof trailers with steel reaches, were put in service toward the end of the season. A sample of trees was put through the Susanville mill by cooperation of the Division of Products, Region 5, the Lassen forest personnel, and the Fruit Growers Supply Company.

The second block of methods of cutting plots was cut over and records completed except for the damage survey which must await slash burning. The third block of six 30-acre plots was surveyed and staked in preparation for cutting next year.

The area cut under the preliminary light insect control salvage treatment was brought up to about one thousand acres. Insect losses on the treated area have been reduced by about 90 percent as compared with untreated check areas. On the check areas, losses have been confined almost entirely to trees designated as "highly susceptible" by the Bureau of Entomology and Plant Quarantine. The general trend of losses in untreated stands has been downward in the last few years. Average losses were about 200 bd. ft. to the acre a year between 1933 and 1937 and have been about 100 bd. ft. in the last two years. It remains to be seen whether or not the treatment is effective against a rising insect tide. This season losses increased, suggesting commencement of

the upward trend in the insect cycle. It was hoped that the major portion of the experimental forest would have received the preliminary selective insect control treatment by the time this upward trend began. Delay in obtaining a railroad siding near the area has restricted cutting. The decision has been made not to introduce direct insect control methods by treating infested trees in surrounding virgin timber even though pressure on the small cut-over area may be greater than was anticipated in the work plan.

### Central States

Conversion Studies. There has been, is, and, in all probability always will be, lots of blackjack oak in the Missouri Ozarks. However, it is believed that the size of the individual stands and the total acreage of pure stands of blackjack oak are gravely exaggerated by those who have only a "highway" acquaintance with the forests in the Missouri Ozarks. During the last two years, considerable difficulty has been encountered in finding suitable stands of sufficient size and percentage of blackjack for the establishment of our sprouting study plots. On these plots it was later found that the blackjack oak was dying at a much greater rate than were the rest of the oaks, the hickory and the pine. During October and November, a study was made of 100 stands picked at random from those that were mapped as pure stands of blackjack oak on the acquisition maps and 50 stands along the highway that appeared to be pure stands of blackjack oak. The trees in these stands were tallied by species, d.b.h., crown class and vigor. Although the data have not been analyzed, it is evident that many of the stands which appear to be pure stands of blackjack oak include small stems of desirable species, and that, because of the higher mortality of the blackjack oak, the number of pure stands is continually being reduced.

Chestnut Oak Regeneration. A preliminary report on chestnut oak reproduction on clear cut and partially cut (50 percent removal of total basal area) plots ten years after establishment, sets forth the following:

1. The regeneration of chestnut oak on the clear cut area was more successful than on the partially cut area.

2. On the clear cut plot the survival of chestnut oak seedlings was better than that of chestnut oak sprouts. The seedlings increased from 70 to 84 percent of the total amount of chestnut oak reproduction in the last five years.

3. On the areas studied, there was never any danger of a serious invasion by brush or by inferior species. At present, the partially cut plot has the largest percentage of other species and the clear cut plot the least.

4. A cleaning applied five years ago, the fifth year after cutting, reduced all sprout clumps to one stem on a portion of the clear cut area. Thus far, the seedlings of chestnut oak have shown no significant response to this measure either in survival or height growth. However, the sprouts on the cleaned area are only about half as tall as the sprouts on the untreated area. Also, other species are considerably less in number on the cleaned portion of the plot.

Methods of Cutting. A ten year remeasurement of the growth plots on the Clark County State Forest in Indiana, was made during the past field season. Growth records obtained from this study are representative of some of the best stocked types of uneven-aged, second growth forest of mixed species. At the time of establishment, the stand was found to contain an average of about 200 trees per acres above 2.5 inches d.b.h. About sixty percent of the number of trees tallied were white oak. In the 1928-29 cutting, directed primarily toward the removal of large undesirable trees from competition with the younger stand, an average of nine trees per acre were removed. Scarlet and Dark oak, along with the hickories formed the major part of the cut. Intensity of cutting on the tenth acre strip plots varied from no cutting to removal of 75 percent of the total basal area. Comparison of present with original stand tables discloses that the increased percentage of white oak in the older stand and in younger age classes has been maintained, with a uniform increase in size for all diameter classes during the past ten years.

Site Improvement. Data on the current project of soil building following abandonment show that under sassafras there is a highly significant increase in infiltration rate. Under black locust there is no significant increase in infiltration rate. Incorporation of organic matter ensues under sassafras with restoration of the A<sub>1</sub> horizon. Very little organic matter is incorporated under black locust. Under sassafras a forest litter cover forms; under black locust a grass cover develops. The amount of litter laid down from locust and sassafras are approximately the same; but the types of decomposition are different. Black locust is not a good nurse crop from the forest soil standpoint. Sassafras may be the solution for reestablishing forest conditions on certain heavy clay soils where pines fail.

#### Lake States.

Timber Sales. Timber sales at the Upper Peninsula Branch Station are picking up and we now have 26 small sales in an active status. If business continues to improve, we will probably attain our allowable annual cut of half a million feet for the experimental forest during the coming year.

Christmas Trees. Some interesting aspects of the use of black spruce for Christmas trees have been disclosed in preliminary investigations made by the Station during the past field season:

1. The best-grade trees come from low-quality swamps that are often too poor to grow pulpwood.

2. The high-grade Christmas trees are practically all obtained by "topping" trees 15 to 30 feet in height.

3. Relatively few swamps contain trees of the proper type. No conclusions have been reached as to what site factors determine the production of good tops. However, the rate of height growth is an important factor because trees that grow too fast lack satisfactory density of foliage, and trees that grow too slowly are flattened and too heavily branched.

4. "Good" Christmas-tree stands support 1,500 to 4,000 stems per acre of which, on the average, less than 10 percent have acceptable tops. The trees are from 80 to 160 years old and the 3- or 4-foot tops are 8 to 12 years old.

5. Within a good stand, the selection of trees is based almost entirely upon symmetry and form of the top. It is likely that several successive cuts equal to the first one can be made at about 10-year intervals, since completely new tops are formed that often.

6. In this type of stand there are few or no opportunities to encourage the development of new tops from live branches on the stump because there are not many thrifty branches within six or seven feet of the ground.

Local Variations in Development of Red Pine Cones. During August and September 1939, collections of red pine cones were made at 10-day intervals in two localities in lower Michigan, one near Roscommon and one about 40 miles to the east on the Huron National Forest. Despite the short distance separating the two localities and the similar age of seed trees (averaging between 50 and 60 years) some distinct differences in cone characteristics were noted.

The cones from the Huron were consistently longer and heavier than those from Roscommon, and yielded more seed. However, the Roscommon cones (except for the very last collection) produced heavier seed than the Huron cones.

Our knowledge is not yet great enough to pin down to specific causes the reasons for these differences, but the fact that there are such differences in localities relatively close together may be but one more reason for being very particular as to using local seed sources in our planting program.

## Northeastern

### Stand Improvement

Remeasurement of a series of 4 thinning plots on the Gale River Experimental Forest in a 60-year even aged spruce-fir stand showed greatest stimulation of growth occurring in the plot subjected to the heaviest thinning. However, greatest wood volume was produced on the lightest thinned plot containing the largest growing stock, where volume production averaged 73.4 cubic feet per year in contrast to 58.8 ft. on the heaviest thinned plot.

The stand selected for the thinning experiment is typical of extensive areas of second growth in the spruce region springing up following fire or clear cutting. It consists mainly of red spruce and balsam fir with a scattering of pine and northern hardwoods. After a period, growth slows down, due to an overcrowded condition, and after 40 years balsam fir shows evidence of deterioration. The objectives of the thinning experiment are two-fold; to determine the practicability of light but frequent cuttings as a means of (1) salvaging balsam which under a long cutting cycle would be lost through rot and wind-throw, and (2) of building up and maintaining a large growing stock.

A departure from the traditional system of thinning was undertaken. Instead of removing definite percentages of the stand, emphasis was placed on reducing the growing stock to specific amounts. Thus the growing stock on the heavy, medium, and light thinning was reduced to 100, 120, and 140 basal-area square feet respectively. Only 5 years have transpired since the initiation of the experiment. However, the data illustrate the point that maximum production and returns on investments do not necessarily go hand in hand. It is possible that stimulated growth on the heavily thinned plot may continue over a long period and ultimately produce greater volume growth than the more lightly thinned plot.

## Northern Rocky Mountain

Reproduction Cuttings in Deception Creek. Recent reproduction surveys of four western white pine cutting areas within the Deception Creek Experimental Forest show that restocking, though gradual, is progressing satisfactorily on most areas. The surveys further show pronounced differences in rate of restocking by situations, aspects, and degrees of overwood removal. All surveys were made by means of

continuous quadrat transects which were permanently marked in order that the same ground areas may be covered in future examinations.

Three of the areas examined are shelterwood cuttings with a reserved stand composed of almost pure mature western white pine. Two of these areas are 8 acres in size and lie on a steep, north-facing slope; the third area covers 15 acres and is located on a steep, south-facing slope. The fourth area, 40 acres in extent, on a steep, northeasterly facing slope, is a strip cutting consisting of alternate clearcut strips and shelterwood strips of mature white pine.

In brief, the surveys show that (1) restocking on all areas is progressing rather gradually, (2) restocking of north-slope shelterwood areas is progressing much more rapidly than south-slope shelterwoods, (3) on the strip cuttings the shelterwood strips are restocking much more rapidly than the intervening clearcut strips, (4) restocking on all areas is best on lower slopes and poorest on upper slopes.

These surveys are much too soon after cutting to predict rates of restocking. However, they do emphasize once again the need for a continued seed supply on cut-over areas in the western white pine type if the land is to be satisfactorily restocked. Restocking after cutting in the type is by and large a rather slow, gradual process. On the cutting areas examined, it is not expected that the removal cuttings of the shelterwood can be made for a period much less than 10 to 15 years following the initial cutting.

Winter Stand Improvement Program. Plans and instructions for stand improvement work to be done during the winter of 1939-40 by CCC labor in the Priest River Experimental Forest were completed by Wellner during November. Included in the program are 48 acres of thinnings, 220 acres of pruning, and disposal of defective trees on 17 acres.

Thinnings will be mainly from below in dense, poor-growth stands of western white pine and associated species. Their aim is to provide release to overstory trees and the better western red cedar stems in the understory. As available time and personnel do not permit detailed plot installations, thinning areas are designed to give as much experimental control as possible with the minimum of field work. Each thinning area consists of alternate thinned strips 3 chains in width and unthinned strips 2 to 3 chains wide. All strips are 10 chains in length. Each strip is constant to one thinning treatment and each treatment is replicated 2 or 3 times. It is believed that a design of this type has real value in extensive experimental stand improvement operations which cannot be given detailed experimental control.

Pruning will be restricted to western white pine and ponderosa pine but will include diameter classes from 4 to 20 inches, d.b.h., for these species.

Disposal of defective trees will be carried out on two logged-over areas now supporting mixed stands containing a high proportion of defective trees. These latter will be felled and the resulting slash progressively burned. The remaining stand will contain numerous trees of high value species to seed in openings created by the disposal work.

This program continues the work of last winter when 25 acres of thinnings in stands similar to those to be thinned this winter, 300 acres of pruning in young ponderosa pine and 50 acres of defective tree disposal work, were completed.

Seed Tree Mortality in a Shelterwood Strip Cutting. The Ames Creek strip shelterwood cutting on the Deception Creek Experimental Forest has yielded some information on seed-tree mortality following cutting in mature western white pine stands. This 35.4-acre area, supporting a choice 160-year-old timber stand with a gross volume of 54,368 feet per acre, 78 percent western white pine, was cut in 1935 in alternate clearcut and shelterwood strips. The clearcut strips were broadcast burned following felling of all unmerchantable timber left after logging. On the shelterwood strips, occupying just half of the area, about 60 percent of the white pine volume was logged, and in a supplemental stand improvement operation a hemlock understory and all but a few of the best trees other than white pine were removed and the slash piled and burned. This left an open shelterwood principally composed of choice 6- to 8-log white pine trees selected for their good crowns and general vigor. These trees were tagged in 1936 and annual examinations for mortality have since been made giving four years of records at the end of 1939.

In this four-year period, 23 percent of the white pine seed trees have died as shown below.

	<u>Number</u>	<u>Percent</u>
<u>Trees dead by cause</u>		
Wind	70	14
Insects	35	7
Fire (slash burning)	3	1
Miscellaneous	<u>5</u>	<u>1</u>
Total dead	113	23
<u>Trees alive in 1939</u>	<u>378</u>	<u>77</u>
Total on area	491	100



This total mortality is really surprisingly high considering that the area is mostly in a sheltered cove, and on first inspection one is not conscious of the loss. As shown, wind has been the chief cause of mortality. Nearly all of this damage occurred on a shoulder of an upper slope where the wind got a clear sweep. This bit of evidence further indicates the inadvisability of leaving scattered seed trees on exposed situations. Mechanical weakening of the trees by root rot, mainly caused by Armillaria mellea, contributed to this windthrow. Extensive root rot was evident on most of the windthrown trees.

Although the direct loss attributed to fire was very small, it was thought that even light scorching might predispose white pine trees to attack by insects which accounted for nearly a third of the total mortality. Analysis of insect losses to trees showing some fire damage from slash burning in relation to insect losses to trees not fire damaged, did not, however, indicate any predisposition of fire-damaged trees to insect attack.

A consolation for these losses has been that good accessibility and the close utilization practiced on the forest has permitted commercial salvage of much of the timber dying.

### Pacific Northwest

Douglas Fir Region. The installment cutting study at the Simpson Logging Company's operation continued to take a good share of Kolbe's time in October. The final cutting has now about been completed but the final examination thereafter has not yet been given.

One new group of Douglas fir selective logging plots was put in on the sale area at Westfir, Oregon. This is an exceedingly interesting area as it presents a wide range of stand conditions in decadent Douglas fir. The proposed removal of 35 percent of the sound high value fir may, in different parts of the area, result in a reserve stand of any one of the following: (a) highly decadent, old-growth fir-hemlock, (b) low grade, pure hemlock of all ages, (c) mixture of understory hemlock and young-growth Douglas fir that sprang up in the larger openings among scattered old veterans, (d) or a fairly sound stand of hemlock approaching merchantable size. Some of this stand was subject to windfall under virgin conditions and there is little doubt that windfall will be accelerated by the selective cutting on parts of the area at least.

Munger revisited the Cedar River watershed of the city of Seattle and was impressed by what 15 years of good protection and intensive forest management has done. Thirty thousand acres that was once bristling with snags and but scantily stocked with reproduction and very liable to fires is now a sea of well stocked,

thrifty reproduction without snags and well safeguarded from fire by a transportation system and its own continuous forest cover.

Ponderosa Pine Region. The permanent methods of cutting plots which were up for reexamination this fall were not remeasured due to lack of personnel. This necessary work must therefore be held over until spring. Computation of the 395 plots used to sample the maturity selection system cutting of 40 thousand acres on the Malheur National Forest is under way. These plots are divided between two types of marking of about equal intensity. Preliminary figures indicate that considerable difference in the stand structure results after these two variations in application of the maturity selection system. Kolbe has prepared stand and stock tables for a tract of 10 thousand acres on the Malheur Forest that had been cut under the standard 80 percent method prior to the adoption of the maturity selection system. Tables of mortality following cutting have been prepared as a supplement to an earlier report and embodying the field work of 1937.

Selective Timber Management in Douglas Fir. On November 16 the last of approximately 15 million board feet of logs were removed from a 160-acre experimental cutting area on which the Simpson Logging Company had been operating since early in July. On this area four separate cuts, in addition to an initial removal of more than one million board feet of large merchantable windfalls, were taken one after another until the entire merchantable stand was logged. More than one thousand large overmature Douglas fir trees, averaging about 10 M board feet in volume, were tagged, numbered, and log graded before felling, scaled after felling, and finally scaled and graded in the raft by the Puget Sound Log Scaling and Grading Bureau. Completion of this final Bureau scale and grade record is expected early in December, after which an analysis will be made of the "fall down" in scale and grade from the standing tree to the raft. Another important phase of the study will be the comparison of present and future financial returns under various forms and degrees of selective cutting.

## Southern

Lightning The Cause Of Much Timber Mortality. During the past two years Reynolds has salvaged all merchantable timber that has died from various causes on the Crossett Experimental Forest. This salvage work has presented an excellent opportunity to determine the amount of mortality per acre per year and the cause of the death of each individual tree salvaged. Contrary to the popular belief that most mortality in selectively-cut as well as uncut stands is caused by wind and "bugs," it has been of interest to find that lightning has been directly responsible for fully 70 percent of the total volume loss.

It is also interesting to note that although over 50 percent of all trees 4 inches d.b.h. and above that have died during this

period were killed by insects, lightning has been indirectly responsible for the death of a large majority of these. In most cases the beetles have been attracted to the lightning-killed or weakened tree and have later attacked and killed from a few to several surrounding trees of smaller size.

Very few lightning storms pass that do not kill or injure some trees, and two recent storms have been responsible for the death of at least 11 shortleaf and loblolly pine trees ranging from 13 to 20 inches in diameter on the 1680-acre Experimental Forest. Since the trees killed are usually some of the largest in the stands a severe storm may account for a relatively large loss of volume. Of course, severe storms may occur only once or twice each year, and most of them to date have not killed or injured as many trees as the above two mentioned so that the total loss over an average of several years' time is not a serious handicap to selective cutting or other good forest practice.

One should not assume from this that trees severely injured through poor felling practice will not be attacked and killed by Ips or Dendroctonus beetles because in some cases a large annual loss of volume may occur as a result of poor work on the part of timber cutters. Where the cutting is carefully done, however, it appears that lightning is the chief cause of loss of volume through mortality in selectively-cut stands.

### Southwestern

Seeds of Pinus quadrifolia. Seeds or nuts of Parry pinon (Pinus quadrifolia Parry ex Sudw., known also as P. parryana Engelm.) have been compared with other pinon nuts and found to be very similar to those of P. monophylla. A sample from the 1939 seed crop in the Santa Rosa Mountains near Indio, California, was obtained through the courtesy of the Bureau of Plant Industry.

The nuts resemble those of P. monophylla in size and shape, being larger than nuts of P. edulis and P. combroides. They are long and narrow with tapering points, averaging 15.6 mm (from 13 to 17 mm) long, 8.5 mm broad, and 7.1 mm thick. The thin shells are only .2 to .3 mm in thickness and easily cracked. The color, which may be expected to vary somewhat in other samples, is mottled dark and light brown on the surface next to the cone scale and dark brown on the opposite surface. Cotyledons vary from 6 to 9.

The number per pound is approximately 1200 of recently matured nuts and probably would be more than 1300 per pound of fully dried nuts. As in other pinons, an unknown and probably highly variable percentage of nuts is empty or "blighted." These empty

nuts, which can be distinguished by their paler color, ordinarily are not gathered or are separated out before the nuts are marketed.

Results of chemical analyses of nuts, including iodine numbers, will be awaited with interest. The taste is mealy, like that of P. monophylla, and quite distinct from the oily flavor of P. edulis. It is probably that the nuts are high in carbohydrates and low in fats. Chemical analyses are to be made by the New Mexico Agricultural Experiment Station, a cooperating institution, which is making a study of the food value of pinon nuts.

Because of the restricted range of the species, pinon nuts of P. quadrifolia are not of much commercial importance. This species is confined to two counties, Riverside and San Diego, of extreme southern California and to a slightly larger area in northern Lower California. It overlaps with P. monophylla, which, according to published accounts, occurs mostly at lower altitudes where the two meet.

In spite of extreme differences in number of needles, P. quadrifolia with 4 ( 3 to 5) needles in a fascicle and P. monophylla with 1 (or 2) are perhaps the most closely related of the four species of pinons. If marketed, nuts of P. quadrifolia probably would not be distinguished from those of P. monophylla. The smaller oily pinon nuts of P. edulis, which are preferred by most persons, find a much more ready sale in eastern markets than nuts of P. monophylla.

## FOREST PRODUCTS

### TIMBER HARVESTING AND CONVERSION

#### California

Log Grade Conference. On November 27-29 something over 30 persons, representing six western Stations, the Forest Products Laboratory, the Washington office of Research, most of the Regional Offices, the Western Pine Association and two or three lumber companies, assembled at the Feather River Branch Station for a conference on log grading. Its object was to harmonize the three log grading schemes which had been developed at the three westernmost experiment Station of the Service, with special reference to ponderosa pine, into one scheme of grades, if that were feasible, for the entire range of that species. The conference was most fruitful and resulted in the appointment of the technicians of the three Stations as a Committee which will meet at Portland in mid-December to carry out the decisions of the conference in a report

for the approval of the participating agencies. It was felt by all the men participating that this conference was one of the most constructive and fruitful they had ever attended and the prospects seem bright for real accomplishment in this important matter for all timber foresters. The conference closed with a round-up discussion of the present status and future objectives and course of logging and milling studies in Forest Service research.

### Pacific Northwest

Pine Mill Studies. Office work on the combined report of the mills studied to date has been temporarily discontinued in order to give priority to the compilation of results on the J. Neils Lumber Company study conducted during September and early October. This work is approximately half done, but is not sufficiently advanced to permit conclusions.

## WOOD PRESERVATION

### Northern Rocky Mountain

Service records obtained by Whitney and Wirka during an inspection of experimental fence posts at the U.S. Range Livestock Experiment Station, Miles City, Montana, in September were recently compiled and analyzed.

The main purpose of this cooperative project is to determine the effectiveness of the steeping treatment in extending the life of lodgepole pine, ponderosa pine, cottonwood, green ash, and western red cedar fence posts. In using this process, part of the posts of each species were submerged in 6-percent solutions of zinc chloride and part in 3-percent solutions of sodium fluoride for 3 to 7 days.

These posts were treated and set in 1926. At the end of 13 years it is evident that those treated with zinc chloride are giving much better service than the sodium fluoride treated posts. The renewal records in each case afford a good basis for tentative estimates of comparative life expectancies. Only 15 percent of all posts treated with zinc chloride have been renewed, while in the same length of time and under similar conditions of service 40 percent of the sodium fluoride treated posts have required replacement because of decay.

With the single exception of the green ash groups, for which there is little difference between the present renewal percentages, average life figures for the zinc chloride treated posts will be considerably higher than those resulting from the sodium fluoride treatments. The following life expectancy estimates for the ash, cottonwood, lodgepole pine, and ponderosa pine posts are based on comparative renewal percentages supplemented by other inspection records which indicate the rate of deterioration occurring in each group.

Species	Shape	Untreated posts average life	Posts treated by steeping process	
			Sodium fluoride	Zinc chloride
			Estimated average life	Estimated average life
		<u>Years</u>	<u>Years</u>	<u>Years</u>
Ash, green	Round	8.6 <u>1/</u>	12.0	12.5
Cottonwood	"	6.5 <u>1/</u>	9.0	13.0
Lodgepole pine	"	9.5 <u>2/</u>	13.0	15.0
Ponderosa pine	"	9.0 <u>2/</u>	10.5	16.0
Ponderosa pine	Split	8.0 <u>2/</u>	14.0	16.0

1/ Actual average life. All untreated posts have been renewed.

2/ Estimated average life. Sixty-five percent of the lodgepole pine, 68 percent of the round ponderosa pine, and 83 percent of the split ponderosa pine posts have been renewed.

The untreated posts were in all cases comparable in size to the treated posts of the same species. Top diameters of the lodgepole pine and ponderosa pine posts averaged about 6 inches. Average life figures indicated for the untreated pine posts in this series of tests are considerably higher than those resulting from some other tests in this region.

## FOREST AND RANGE INFLUENCES

### FLOOD CONTROL SURVEYS

#### Allegheny

##### Preliminary Examinations

The preliminary examination report of the Pequest River has been submitted to the Working Committee. The next preliminary examination undertaken will be that of the Schuylkill River.

##### Watershed Surveys

The report on Codorus Creek has been approved by the Field Coordinating Committee and transmitted to Washington. The Field Working Committee is now reviewing and editing the report of the Youghiogheny River.

The initial stages of new surveys have been begun on the Upper Susquehanna and Allegheny Rivers. Stream gauge installations and snow and infiltration studies will be among the first activities undertaken on these watersheds.

#### Appalachian

##### Watershed Surveys

The flood control survey on the Potomac River watershed was started in October. Field headquarters are located at Winchester, Virginia.

The Station is also cooperating on the survey of the Pee Dee River watershed in North and South Carolina. Field headquarters for the Pee Dee survey are located at Salisbury, North Carolina.

#### California

Flood Control Hearings. On November 8 a public hearing on the Lower Klamath River was held jointly by the Departments of War and Agriculture at Klamath, Del Norte County. A delegation of about 100 interested citizens presented the local flood problems, and representatives of the Departments were taken by boat down the Lower Klamath to obtain first-hand flood and flood damage information.

### Preliminary Examinations

Field examination of the 1620-square-mile Santa Clara Watershed has been completed and preliminary examination reports are in progress for (1) the Walker watershed, covering approximately 4,000 square miles and (2) for the Santa Ynez watershed, of about 900 square miles.

Office work is under way for six other watersheds that embrace 14,000 square miles, including the San Diego Group, American, Russian, Eel and Mad, Carson and Arroyo Grande Rivers.

### Watershed Surveys

The first survey report by Field Coordinating Committee 18 made in compliance with the Flood Control Act of June 22, 1936, was completed and submitted to the Washington Coordinating Committee in October. The report covered the survey of the Los Angeles River Watershed with recommendations for land treatment and structural measures designed to reduce the flood hazards at or near the points of origin. In 1938 the flood damage in this watershed reached a total of \$38,000,000 and 45 lives. The expected flood damage during the next 50 years, in the absence of the proposed Department of Agriculture program and of the downstream works proposed but not yet constructed, is estimated at \$330,250,000, or an average annual damage of about \$6,605,000.

Approximately 43 percent of the Los Angeles Watershed is mountain land of which some 60 percent is publicly owned. Agricultural land makes up about 22 percent of the watershed with the remainder, or 35 percent, used largely for urban and suburban purposes.

The flood problem is intensified by the presence of highly developed urban and industrial areas on the alluvial plain between the Pacific Ocean and the south front of the San Gabriel Mountains. Reduction of flood damages in these areas will be accomplished upon completion of the comprehensive downstream plan of the Corps of Engineers and the Los Angeles County Flood Control District supplemented by the proposed Department of Agriculture program of runoff and water flow retardation and soil erosion prevention. The program includes the improvement of fire control measures; road erosion control and drainage improvement; improvement of the vegetal cover on mountain slopes; upstream channel control and stabilization; cultural treatment and changes in land use on agricultural lands; and secondary channel improvement in valley agricultural lands.

Survey work has been started on the San Gabriel Watershed and is now well under way with damage surveys nearing completion by the economists and the field work on the agricultural and mountain areas about fifty percent complete.



In preparation for future work on the Santa Ana River Watershed, fifteen intensity-recording rain gages were installed to supplement the limited hydrologic data available in this area. Location of the gages was made after consultation with the Weather Bureau, San Bernardino County Flood Control District, and the San Dimas Experimental Forest staff. Maintenance of the gages will be provided by local cooperation.

## Central States

### Preliminary Examinations

The preliminary examination report on the Wolf River Watershed, Tennessee and Mississippi, has just been completed. Cumberland River Watershed has been selected as the next watershed for preliminary study.

### Watershed Surveys

St. Francis Survey. The rough draft of the Detailed Survey Report has not been completed. It will probably be in shape for consideration by the Field Coordinating Committee early in December. Supplemental reports in rough draft have been completed for the infiltration study, the forest fire problem, the erosion study, the detention reservoir survey, the road erosion survey, and procedures and methodology.

Muskingum Survey. The Muskingum Survey has been granted an extension of time to July 1, 1940. A unit report on Raccoon Creek will be submitted to Washington.

The Forest Service representatives have been working on the Licking Watershed and have been making a study of forest problems as they relate to flood control in the southern part of the Muskingum Watershed.

## Intermountain

Boise River. The Boise River Survey project is now entering final stages, with completion expected sometime after the first of the year. Major current effort is centering on sifting optional programs of remedial measures to arrive at the most feasible plan, and the coordination of this upstream program with measures recommended by the U. S. Corps of Engineers.

The U. S. Geological Survey through cooperative arrangements, recently furnished the survey project with data on discharge and silt loads from thirteen stations on the Boise River covering the period January to June 1939. The data from this preliminary report are being

used as a basis for making tentative estimates of the yields of silt from flood source areas. The period of record was characterized by only 75 percent of normal runoff and less than 50 percent of maximum mean daily discharge.

#### Preliminary Examination

A preliminary examination report on the Sevier Lake Watershed, Great Basin, Utah, has been completed and forwarded to Washington. A detailed work plan for a survey on this area is nearing completion. The flood problem in this area is characterized by flood and debris damage at the mouths of numerous steep tributaries as well as flood and sedimentation damage along the main Sevier River, which is completely regulated for irrigation purposes. Highly effective upstream measures such as contour trenching, reseeding, and improved range management practices are known to be applicable to the area, but a survey is needed to determine the scope of such a program in keeping with economic limitations.

#### Pacific Northwest

A rough draft of the work outline for the Willamette River has been prepared and is ready for review and revision by the other bureaus. The preliminary flood control report for the Puyallup River has been completed and transmitted to the BAE and SCS for comments.

On October 26 a public hearing was held jointly by the Department of War and Agriculture on the Siuslaw River, Oregon, and on November 1 a similar hearing was held on the Skykomish River, Washington. Chapler represented the Department of Agriculture at these hearings. He also attended a hearing on the Moses Coulee, held at Wenatchee on October 10.

#### Southern

The Trinity River survey in Texas, under the chairmanship of the SCS, was completed, and the report submitted to Washington in mid-November. The South Concho River (tributary of the Colorado River, in Texas) survey field work is completed and the report will soon be ready for review by the field working committee. Field work on the Little Tallahatchie survey, was completed in July.

The Little Tallahatchie survey party, with additional personnel has begun work on the remainder of the Yazoo basin. Of the Trinity survey Forest Service personnel, Dyksterhuis is now Forest Service Senior Representative on the Grand-Neosho survey (Kansas, Oklahoma, Arkansas, and Missouri), Baudendistel is assigned to the New Orleans office to work with Smith on preliminary examination reports, and Olsen, assigned

temporarily to the New Orleans office, will go to the Lower Arkansas survey when it is authorized.

Work in New Orleans has largely been centered around preparation of survey work outlines for the Yazoo, White, and Ouachita River surveys, with assistance to the SCS in the preparation of work outlines for the Grand-Neosho, Lower Arkansas, and Pecan Bayou (tributary of the Colorado River) surveys.

## INFLUENCE OF NATURAL VEGETATION ON STREAMFLOW

### Appalachian

A New Type Weir. During November two new-type modified deep-notch weirs were completed and installed on the Cowceta Experimental Forest. This weir has a 6-foot central ogee section, built with vertical sides rounded on the upstream edge. The ogee section, originally developed for the Columbus weir, is formed by the use of an alloy casting made by the Bureau of Standards. The cutoff wall and the remainder of the flow section are made of standard lumber.

The weir is designed to operate accurately without a ponding basin and to clean itself of silt, sand, and small debris. It will give accurate measurements for both low and relatively high flows and is considered particularly useful for small drainage areas where the land-use conditions give rise to a wide range between low and peak flows.

A rating table for this weir is now being prepared at the hydrologic laboratory of the Bureau of Standards. As a check on the installation in the field, a 120-degree V-notch control has been established 100 feet downstream to be operated for several months simultaneously with the new deep-notch control.

Analysis of Streamflow Data. Depletion curves have been continuous streams on experimental drainage areas used in forest influences research. The depletion curve of ground water is required for the separation of storm runoff from ground water flow. Several curves were first made up by using the lower tails of recession curves of individual storm hydrographs together with sections of the actual stream hydrograph that were apparently not influenced by storms. These depletion curves were then checked against other curves obtained by plotting the daily mean c.s.m. discharge of one day against that of the following day. It was found that this method

produced approximately the same curve as that obtained by the more difficult and laborious mechanical procedure using the original hydrographs. Further tests of general application of the two procedures are in progress.

### Intermountain

A and B Experimental Watersheds. Inspection of 1938 and 1939 field records from experimental watersheds A and B at the Great Basin Branch Station reveals what seems to be significant changes over relatively short periods in the ability of the soil on these drainages to absorb water.

The data suggest that June storms immediately following spring runoff when soil moisture is relatively high (35 percent) are far less likely to produce runoff and erosion than August storms of approximately similar nature even though soil moisture is relatively low (25 percent). One of the several specific cases will serve to illustrate this point. On June 31, 1938, a 0.31-inch storm occurred during 1 hour 15 minutes, of which 0.17 inch fell in 25 minutes. No runoff occurred on either watershed. On August 25, 0.36 inch of rain fell in 3 hours 15 minutes, of which 0.25 inch fell in 40 minutes. Runoff from A was .11 percent and from B 30.13 percent. In June there were three storms of the same general character varying from 0.30 inch to 0.60 inch, none of which produced runoff; whereas in August there were seven such storms which varied from 0.29 to 0.51 inch, each of which produced runoff from A varying from .11 percent to 9.95 percent and from B of 14 percent to 75.72 percent. It is difficult to examine these data without concluding that there is a real and measurable change in the infiltration rate of the soil between June and August.

These apparent changes in infiltration rate are probably associated with loosening and opening of the soil as a result of repeated freezing and thawing in the spring followed by compaction, shrinkage and plugging of crevices with the powdery soil that develops on the surface as drying occurs during the summer months.

What appears to be an even more rapid change in the ability of soil to absorb rainfall was observed on August 31. In the forenoon 0.15 inch of rain fell over a period of  $1\frac{1}{2}$  hours, of which 0.10 inch fell in 10 minutes. In the afternoon 0.17 inch fell in 50 minutes of which 0.10 inch fell in 12 minutes. Runoff from the morning and afternoon storms was 8.8 percent and 5.0 percent respectively on watershed A and 32.3 percent and 14.7 percent on watershed B. Apparently a thorough wetting of the surface inch of soil by the morning storm greatly increased the infiltration rate.

The influence of type of storm is also brought out by inspection of data for 1938 and 1939. During June to September 1938, 4.19 inches of rain fell in 56 hours as a result of 12 storms which varied from 0.19 to 0.60 inch. Of these storms, 7 produced runoff which amounted to a mean of 3.77 percent for watershed A and 31.73 percent for watershed B. During the same period in 1939, 6.60 inches of water fell in 179 hours as a result of 11 storms which exceeded 0.19 inch each. No runoff occurred on either watershed during the period. The reason for this wide difference in runoff between 1938 and 1939 is to a large extent due to short flashy periods of rainfall in 1938 and almost a total absence of such storms in 1939.

Soil moisture in the 0 to 18 inches layer was 10 percent higher on October 30, 1939 than on the same date in 1938. Infiltration of water into the soil during the 1939 season no doubt contributed largely to this difference. At any rate it is apparent that when spring runoff starts in 1940 the amount of water necessary to recharge the soil mantle sufficiently to produce either seepage or overland flow will be less than that required the preceding year. Measurable effects on stream flow should result.

Installations. Five venturi-trapezoidal flumes have been constructed on as many north tributary watersheds of Farmington Canyon since September 1. An additional installation in the spring of 1940 will complete those planned at the present time. Progress is being made on construction of a concrete and rubble control section at the mouth of Farmington Canyon, a 7,500 acre watershed which will make possible the measurement of stream flow from this drainage, 11 tributaries of which are now being developed into a watershed laboratory.

Catchment tanks at 16 Parrish Creek plots at Wasatch Branch Station have been doubled in size since September 1. These tanks are being equipped with water stage transmitters. Completion of this installation will provide a system of synchronized runoff control on Parrish Creek, a 1,373-acre watershed, at its mouth, 6,000 feet elevation, 7,000 feet elevation (two gages at forks), 7,800 feet elevation, and on 16 small plots in annual weed, aspen, and browse cover respectively above 8,200 feet elevation.

### Lake States

Lysimeter Studies. A manuscript summarizing five years of records for the ten lysimeters at La Crosse, Wisconsin, is now being prepared by C. G. Bates and H. F. Scholz.

Some of the highlights of this paper comprise the following conclusions:

1. Next to fallow plots provided with a good absorbent surface covering, trees are most likely to leave some water in the upper

four feet of soil for replenishment of the ground-water supply.

2. Heavy bluegrass sod permits little runoff but uses and wastes more water than trees. This fact probably is explained by the high retentive capacity of the sod which permits only the heaviest rains to reach deep storage.

3. Field crops (barley and corn) are least effective in replenishing groundwaters. Under these crops 10-12 inches (roughly one-third of the total precipitation) is lost as surface runoff and all water that enters the soil is utilized by the plants.

### Rocky Mountain

During the 1939 field season three new forest influences investigations were initiated on the Fraser Experimental Forest.

Early in the summer, a study was undertaken to determine the volume of intercepted precipitation that occurs as stemflow in the lodgepole pine type of Colorado. The study was given a factorial design which provided for the selection of 120 trees representing: (1) three tree species (lodgepole pine, Engelmann spruce, and alpine fir); (2) seven diameter classes; (3) three crown classes; and (4) two treatment conditions (virgin and cutover). Sheet lead gutters around the study trees, connected by flexible rubber tubing to calibrated galvanized iron cans, are used to collect water flowing down the boles. The summer and fall of 1939 proved to be the driest on record for the Rocky Mountain region, with less than half the number of storms that occur in a normal year. Such storms as did occur produced no stemflow. This study will be continued for another year at least. Later it is planned to transfer the equipment to a suitable stand of aspen.

The equipment for the snow evaporation study is now completed and measurements will be made in the early spring of 1940.

Measurement of year-long stream discharge has been begun on Fool's creek, a 700-acre drainage in the Fraser Experimental Forest. The gaging station, designed to measure flows under adverse winter conditions, consists of a one-foot San Dimas flume for measuring normal spring freshet runoff, with supplemental 4-foot and 6-foot broad-crested weirs for unusually high flows. For measuring low winter flows a plate containing three bell-mouth orifices is dropped into the San Dimas flume, and the whole structure is protected from freezing by timber and sawdust coverings. A single stilling well, containing a build-in ground-water well, serves to measure heads on the orifices and depths in the San Dimas flume and on both broad-crested weirs. The measuring range of the structure is from 0.08 to over 60 cubic feet per second.

Southern

Hoover-Nesbitt Watershed Studies. The four watersheds, which lie on the forks of Hoover and Hesbitt Creeks of the Irons Fork Experimental Forest and on the southern face of the Irons Fork Mountain syncline, are dry, for the most part, during the summer month of July, August, and September. Springs, however, near the head of the watersheds have been observed to flow throughout this period. In an effort to determine the role of these springs on total watershed yield and the effects of precipitation and seasonal consumptive use on spring flow, sharp-crested V-notch weirs were installed on three springs, and semiweekly readings were made of current discharge. Though discharge is small (60 to 115 gallons per hour), further investigation on the origin of the spring water may cast light on the importance of geologic structure on stream flow in the Ouachita Mountains.

Geologic mapping of the 8,000-acre Irons Fork Experimental Forest on a scale of 16 inches to 1 mile was begun under a WPA project. It is expected to be completed by June 1940.

Southwestern

Vegetational changes on the Parker Creek Watershed. Plots established in the fall of 1934 for study of changes in herbaceous cover in the ponderosa-pine type on the Parker Creek Watershed area were rechecked in November of this year. At the time of establishment, measurements of the areas covered by tree trunks and canopies were taken on a large plot and within this area 4 small plots, 10x10 feet in size, were located. On the smaller plots the location of herbaceous plants and small shrubs was plotted and measurements of areas covered by individual plants were recorded in square inches.

The watershed area was fenced in the fall of 1932 and at that time the stony ground surface partially covered by pine needles was fairly well protected from erosion, but in the large openings between clumps of trees considerable soil washing was indicated by the presence of deposits of silt and sand impounded behind twigs, branches, and other obstructions. Very little grass was present.

At the time of recharting, no striking changes were observed in the amount of surface covered by tree growth, but substantial increases were recorded in the densities of small shrubs and grasses, particularly the latter, on the three plots within the fenced portion of the watershed. These increases resulted from the spread of old tufts or clumps and the appearance of new plants. The changes by species are indicated in the following table:

## Vegetation measurements on three plots in the ponderosa-pine type -- Parker Creek watershed

Species	Common name	Area in sq. in. fall of 1934	Area in sq. in. fall of 1939	Increase in sq. in.
<i>Sporobolus interruptus</i>	Black dropseed	418	831	413
<i>Poa fendleriana</i>	Muttongrass	63	221	158
<i>Andropogon barbinodis</i>	Cane beardgrass	17	17	0
<i>Muhlenbergia rigens</i>	Deergrass	3	15	12
<i>Piptochaetium fimbriatum</i>	Pinyon ricegrass	46	65	19
<i>Aristida orcuttiana</i>	Beggar tickgrass	13	20	7
<i>Ceanothus fendleri</i>	Small deerbrush	263	407	144
TOTAL		823	1576	753

While the percentage of ground surface occupied by herbaceous vegetation is not large, the gains made during the 5-year period indicate that grasses probably constituted an important part of the watershed cover under natural conditions.

In a plot just outside the fenced part of the watershed, there was a decrease in the density of herbaceous cover during the 5-year period; only 128 sq. in. of cover was recorded in 1939 as compared to 152 sq. in. in 1934.

The herbaceous vegetation has responded more rapidly on the more inaccessible portions of the watershed where the herbaceous cover was still in fair condition at time of fencing in 1932. The large bunch muhly grasses (*Muhlenbergia rigens*, *M. emersleyi*, and *M. longiligula*) growing several feet in height are now a conspicuous feature of the cover on the higher south-facing exposures. Other grasses, such as *Andropogon scoparius*, *Bouteloua curtipendula*, *Koeleria cristata*, *Muhlenbergia montana*, and *Blepharoneuron tricholopis* are increasing in prominence. On north-facing slopes muttongrass (*Poa fendleriana*) and brome grasses (*Bromus* spp.), accompanied by many herbs and small shrubs, form an almost complete ground cover. Tree cover, in conjunction with litter lodged in these grasses and in clumps of snowberry, Oregon grape, and raspberry, affords complete soil protection as the infiltration capacity of soils so covered is never exceeded by the heaviest rainfall.

Revegetation along stream bottoms has been marked by the spread of vines such as Arizona grape, Virginia creeper, clematis, raspberry, and poison oak, by reproduction of alder, sycamore, and walnut, and



the reappearance of many shade-loving herbs as geraniums, vetches, and peavines.

The revegetation of grasses has also resulted in the healing of erosion scars on the lower slopes where erosion prior to 1932 was especially severe. Gullies which formerly discharged large quantities of erosional debris into the main channel are now almost inactive. Practically no erosion or runoff from summer storms has been measured at the upper gaging station during the last three summer periods. In 1934 the summer flow was equivalent to .09 inch over the watershed; in 1935, .01 inch; in 1936, .004 inch; and in 1937, 1938, and 1939 there was no summer flow at all. Apparently there has been no decrease in winter flow which constitutes about 99 percent of the total water yield.

The cover on south exposures has probably not attained the high density it had prior to deterioration by overgrazing. Because of loss of topsoil, the ground is probably not now capable of supporting a cover as good as the original vegetation was. Apparently, however, the revegetated cover is adequate to protect the soil from erosion from normal summer rainfall. Whether it is sufficient to hold the soil during exceptional rain storms, such as fell at the Steep Slope runoff areas this summer, when 5.02 inches fell in 2-1/4 hours, is problematical.

## STABILIZATION OF SOILS

### Southern

Rock Creek. The soil-moisture deficit produced during the summer has not been diminished by recent rains; stream-channel flow even during rains, has not appeared on drainages of less than 20 acres.

The occurrence of storm runoff in diversion, spreader, and lead-off ditches, in storage pits, and in impounding dams in stream channels indicates that interception by the exposed-soil structures, which have low infiltration capacities, may equal 50 percent of their storage and infiltration capacity. Increasing the depth of the diversion-ditch storage structures without increasing their infiltration capacity commensurate with the greater cost of excavating them, appears unjustified. Diversion spreaders to give the greatest rate of storm-flow disposal should be constructed with the least area exposed to aerial interception.

## RANGE RESEARCH

### ARTIFICIAL REVEGETATION

#### Intermountain

##### Species

Of the four subprojects into which artificial revegetation research is divided the one dealing with species adaptability is of primary importance, at least during the preliminary stage of the research program. Even after four years of experimentation in the Intermountain Region, the question of what to plant has by no means been answered. Therefore, it is important to note that after considerable thought based on studies and experience, a plan of attack of the problem that appears to be efficient and productive has been formulated. This involves, for each problem area, first, a carefully controlled and closely observed test made on a nursery basis of the adaptability of species to the climatic and edaphic conditions of the area; second, a more severe test of the most promising species from the nursery trials on a range plot basis; and finally, if necessary, an investigation as to the causes of failure of species on the range plots.

Further discussion of these three steps follows:

1. Nursery trials: The first maxim in conducting species adaptability trials, although one that has not been recognized from the beginning is that a preliminary test of the adaptability of species to a particular site should be done under as favorable conditions as possible. Plantings should be made under near optimum conditions (within the range of the site being studied) and such factors as inadequate method of planting, or excessive biotic disturbance should not be permitted to determine survival. Intensive treatment involving carefully controlled planting, frequent weeding, and close observation of seedling establishment is required. To attain those objectives and also to permit the testing of a large number of species on an area small enough to be reasonably homogeneous, small plots are indicated. Plots consisting of only three rows 10 feet long spaced 18 to 24 inches apart are being used generally for this study. These can be kept weeded, either by hand or horse-drawn cultivators and can be closely observed. Only small amounts of seed are needed for planting and enough plots to accommodate several hundred species in duplicate require only a fraction of an acre. It is expected that they will be highly successful in showing the adaptability of species to the climate and soil conditions of an area.

Studies of this kind should be located in each of the major vegetation zones requiring artificial revegetation research. The exact site of the studies should be carefully chosen in order that the results can be applied to a number of range trials in the vicinity.

2. Range trials: It is the objective of the nursery trials to reveal those species that are adapted to the climatic and edaphic conditions of a problem area. Since wide scale plantings of these species under range conditions may well be partial or total failures because of the presence of factors which are not operative under nursery conditions, range trials of all species which show promise in the nursery trials are required. These should be made on plots as small as feasible to reduce the work of establishment, the amount of seed required, and the total size of the experimental area.

Planting of plots in the range trial should be done in the manner most conducive to success, so far as this is known. Season, depth, and manner of planting should be as nearly optimum as possible, but the preparation of a seed bed or the elimination of competing species should not receive more attention than could reasonably be given these factors in an actual reseeding operation on the problem area. In order to eliminate the effect of annual fluctuations in weather, plantings should be made over a period of 3 to 5 years and provision for these annual plantings should be made in the design of the experiment.

3. Fundamental studies: It is expected that 300 or more species will be available for the preliminary nursery trials. Those that survive the nursery trial will be available for the range trial, and the successful ones in this test can be recommended for planting. In order to try to increase the number of species that can be recommended it may be desirable to investigate the cause of failure in the range trials of those which have been shown to be adapted to nursery conditions. Fundamental studies of the ecology of the species will be required. Investigation of the relation of the physical and biotic environment to the establishment and growth of these plants under range conditions will be undertaken.

## Northern Rocky Mountain

### Methods

Our past work has indicated fall is preferable to spring for range reseeding and that early spring is normally preferable to late spring dates. Further confirmation of these indications are now available as a result of plantings made near Missoula in the fall of 1938 and the spring of 1939, both subject to growing conditions

of the past season. Midfall (November 4), late fall (December 9) 1938, and early spring (April 10) and late spring (May 10) 1939, plantings were compared for 54 grasses planted and subsequently weeded. Forty-nine of these same grasses were planted in an adjacent area but not weeded - typical of range conditions.

A severe dry spell occurred in May 1939 during which many of the tender seedlings from early spring plantings were killed before they were well rooted. June was rainy and growing conditions were favorable but as usual little rain fell in July and August. Moisture in September penetrated 4-5 inches into the soil to encourage fall growth. Average survival in early December 1939, expressed in percentage of perfect stand for all species and varieties included, is given in the following table:

Season Planted	Weeded	Not Weeded
	<u>Percent</u>	<u>Percent</u>
Midfall	74	39
Late fall	75	41
Early spring	50	24
Late spring	59	1

The weeded rows have a consistently higher survival than the unweeded, showing the effects of competition with weeds under range conditions. This year, weeded late spring plantings, made just prior to good rains of early May, gave better stands than early spring (April) seedlings on the weeded areas. The dry summer almost wiped out the late seedlings on the unweeded area, but 24 percent of a stand survived from the early spring seeding.

The fall seeding dates gave substantially better survival than either of the spring dates as has usually been the case where the following summer is droughty. Splendid stands have resulted from spring seeding in numerous cases, but the foregoing results emphasized the fact that odds against success were multiplied by late spring dates. Early fall dates have given splendid results in some portions of the State with favorable fall moisture. The above tests, however, did not include an early fall date partly because October and November droughts have been prevalent in recent years. For instance, precipitation at Miles City was .06 in October and .03 in November this season. At Missoula, precipitation for November has been 1/2 inch or more below the normal for the month for the past nine successive years. Early fall seeding dates are thus a long gamble.

Conclusions from three depths of planting for crested wheat-grass tests for three seasons at Miles City are not yet final because of the fact that 1/2, 1, and 1-1/2 inches of cover have each in turn given better survival under certain weather and soil conditions. The shallower depth seems superior when rainfall in spring and early summer is in light but well distributed showers. It appears that the 1-inch depth may be the best compromise between better emergence and germination at shallow depths and better survival of the seedlings that do emerge from the greater depth. The latter escapes some portion of the handicap of rapid drying of the top soil. The 1-1/2 inch depth of cover is known to provide a serious handicap to emergence especially on heavy soil.

## GRAZING MANAGEMENT

### California

#### Foothill Ranges

Summer forage conditions. The forage crop during the past summer was markedly different from that of the last four years in several respects, presumably a result of low rainfall during the spring. Forage in swales that stayed green during the four previous years up until July 15 was mostly dry this year by June 10, and the swales furnished little forage this year after May 15. As a result of these forage conditions the cattle began losing weight about a month earlier than usual.

Spanish clover (Lotus americanus) provided very little green feed during the summer period, in contrast to the four previous seasons during which some feed was available from this species practically all summer. This year there was considerable Spanish clover early in the season, but by June 15 much of it was drying on south exposures, followed quickly by general drying on all exposures. As a result of a lack of good summer-growing herbaceous plants, cattle browsed considerably more than usual on shrubby species including coffeeberry (Rhamnus californicus) and wedgeleaf ceanothus (Ceanothus cuneatus).

Two other summer-growing species, tarweed (Homizonia virgata) and turkey mullein (Eremocarpus setigerus), early in the season, at the time the forage inventory was made, were observed in usual abundance, but were comparatively sparse in late summer. Tarweed began to dry and die on south exposures almost as early as Spanish clover.

Several of the plants that survived in the deeper soils of the swales were destroyed by grasshoppers late in June, and cottontail rabbits clipped most of the remaining plants. By the end of the summer season practically no plants could be found over any of the test pastures.

The following measurements from permanent plots indicate the abundance of tarweed in the plant community at maturity and the fluctuations from year to year. On 45 circular plots with a radius of 4 feet, established in 1936, the average number of tarweed plants varied from a maximum of 208 in 1938 to a minimum of 4 in 1939. In 1936 there were only 5 plants per plot and in 1937 it increased to 37. All the plants recorded for 1939, except those for one plot, had been clipped by cottontail rabbits to within 2 or 3 inches of the ground.

Turkey mullein plants were also sparse this season, although they were much more abundant than the tarweed plants. Individuals of this species were counted at maturity on the same 45 circular plots. On the Experimental Range turkey mullein plants are usually most abundant in swales that are grazed off early in the spring. These circular plots were established on the borders of these areas. The number of individual plants per plot varied as follows: 40 in 1936, 296 in 1937, 105 in 1938, and 8 in 1939. Corresponding average heights varied as follows: 6.2 inches in 1936, 2.3 inches in 1937, 1.0 inch in 1938, and .8 inch in 1939. The spread of top varied almost the same as did the height: 8.7 inches in 1936, 3.1 inches in 1937, 1.2 inches in 1938, and 1.3 inches in 1939.

Quail-weight trends. A summary was made of all weight records of trapped birds and of birds taken in the course of the food-habits study, from December 23, 1936 to June 30, 1939. During this period a total of 1,218 weight records were taken and averaged by months for each age-sex group, from all classes of quail over 10 weeks of age. These included 279 records of adult males, 314 of immature males, 231 of adult females, and 394 of immature females. In general, the months from August to March inclusive are well represented as to numbers of birds in each group, while the intervening months, April to July inclusive, are mostly represented by birds shot for the stomach collections.

Generalizations are that throughout the winter months adult males tend to be the heaviest group, followed by immature males, adult females, and immature females, in order, by approximate group differences of 5 grams, on the average.

A general weight peak is reached during January. As would be expected, the immature birds exhibit a sharper rise than do the adults. However, a slight but steady rise is also evident in the adults. This fact is considered a basic one in the life history of these quail as compared with the bobwhite of the north-central states, where the

winter food supply of ground seeds is a vital limiting factor. Here, in spite of a declining seed supply, the quail continue to build up weight after the low summer period. Even though the seed supply is declining, it still remains more than ample to supply the needs of the various animal species dependent on it.

Surprisingly, the general curve drops through February and March, when there is an abundance of green food. At least three factors could play a part in this decline: poor quality of feed (green as compared with seeds), cold and rainy weather during February, and pre-nesting courting activities. The weights of the males continue to decline throughout the spring, even though in April and May a new source of seeds becomes available. This decline is undoubtedly connected with the courting and sentinel duties of the males during this time. The females on the other hand exhibit a sharp rise during April and May, correlated with the laying period. Many hens examined during this time were literally stuffed with developing ova, and some of these weighed in excess of 200 grams. The hen weight curve drops during June and July, correlated with the laying of eggs, nest incubation, and, later, care of the young.

The weights have also been compiled on the basis of one trapping season vs. another. These compilations do not show any significant differences. In general, the highs and lows are closely correlated between years, although in the season of 1936-37, the general average was slightly higher than in 1938-39.

### Intermountain

Range conditions in the Intermountain Region for the season 1939. Range utilization inspection made on a number of forests during the late summer show many of the ranges in the Intermountain Region to have suffered greatly from the drought conditions which prevailed rather generally throughout this region the past summer. Beginning about March 1 and extending into midsummer an increasing deficiency in precipitation is reported for most of the region. On the whole the spring season was somewhat early, followed by a subnormally cold period that extended into early summer. In some localities this condition apparently alleviated to such an extent the impact of the drought that ranges remained in somewhat better condition than might have been expected from the lack of spring and summer storms.

This seems to hold true for the upper Green River ranges, which, although experiencing a marked deficiency in precipitation up to about August 1, were in fair condition at that date. The early spring and the later cool weather helped carry the forage along so that it did not dry up unduly early, although forage production was only about 75 to 85 percent of normal and much below that of better seasons.

Central and western Nevada ranges were about average this year owing mainly to a few timely summer storms which brought the low seasonal precipitation common to this section up to normal, or slightly above in some localities. Lambs left the Elko County and most of the other ranges weighing approximately average or slightly better. Other stock left the summer ranges in fair to good condition.

Extreme eastern Nevada, Utah, and southern Idaho ranges generally were found to have experienced severe drought conditions. For example, ranges in the vicinity of Dixie National Forest were in poor condition, having dried up early as the result of extremely low precipitation prevailing until about September 1, at which time seasonal precipitation was approximately 73 percent of normal. Forage production amounted to from 50 to 75 percent of normal and dried up earlier than usual, making it necessary to remove stock somewhat early to avoid serious overgrazing. Even with early removal of livestock the ranges were closely utilized.

Weather records show that seasonal precipitation amounted to only about 65 percent of normal for northern Utah ranges, while forage production is variously reported to be from 50 to 75 percent of average. Summer storms were local and some small range areas remained in fair condition throughout the season. These forage conditions were reflected in the flesh of livestock. Reports of commission men handling sheep were to the effect that lambs were leaving the various Utah ranges weighing as much as 12 pounds lighter than the average for the past three years, and with from 5 to 15 percent more lambs selling as feeders.

Range lands in southern and central Idaho reached grazing readiness some 10 to 15 years earlier than in past years, and consequently with the lack of summer storms the forage dried up much earlier than usual. Much of the weed growth of such species as balsamroot dried so early that sheep failed to make use of this feed. An average of the total precipitation up to September 1 for Boise and Hailey amounted to only 62 percent of the longtime average. The period from April 1 to September 1 was especially dry, there being a deficiency of 2.14 inches in precipitation at Boise and 1.53 inches at Hailey during the months of April and May alone.

On many areas livestock were permitted to begin grazing early. In general the lambs which were shipped early were in good finish and weighed well up to average, but many of the late lambs were somewhat light. Total forage production was reported as being 75 percent of average.

Under the extremely dry condition prevailing on most of the Idaho ranges, the livestock were, wherever possible, removed from the range early in order to avoid severe injury to plants from excessive soil movement common to the loose granitic soil of this section.



Spring-Fall Ranges

Hazard of Basing Permanent Grazing Capacity on Bromus Tectorum. 1/ Data obtained during the 1937 and 1938 grazing seasons in Gem County, Idaho, and observations throughout the Intermountain region during 1939 make clear the extremely great economic hazard and the management difficulties involved when grazing capacity is based on the fall-annual grass downy chess (Bromus tectorum) locally known as cheatgrass. This hazard consists largely of two elements, somewhat related to each other but still more or less distinct. They are (1) the wide variations in forage production from one year to another, and (2) the uncertainty as to whether there will occur any production great enough in volume to serve as a basis for livestock grazing. These statements derive most of their importance from the comparison between downy chess and the perennial forage species that only a few years ago constituted most of the plant cover and yielded most of the forage for livestock.

Downy chess, beginning about 1900 spread over the Intermountain region, occupying bare and nearly bare areas where the natural plant cover had either been broken or was greatly deteriorated. This plant species normally begins growth in autumn when it forms winter tufts, from which the following spring seed stalks grow rapidly as soon as warm weather commences. If dry fall weather delays germination till spring, the volume of growth is greatly decreased. When a dry fall is succeeded by a cold spring, or by a dry one, vegetative growth is extremely dwarfed, as occurred in 1937 in Gem County, Idaho. When moisture is abundant in both fall and spring, growth is vigorous as in 1938. In 1939 with low spring precipitation downy chess has made little more growth than it did in 1937.

Downy chess is a problem plant especially on spring ranges because it is widespread and frequently occurs almost to the exclusion of perennial plants. Its high inflammability when dry makes the occurrence of grass fires frequent and these tend to eliminate most of the perennial plants that are still left, but does not injure downy chess. This plant is soft and fresh only during 4 to 6 weeks of spring and much less palatable for cattle and sheep during the remainder of the year, though now fall growth is readily eaten. The old stems are also consumed to some extent in fall and winter when they are soaked by wet snow or prolonged rains, though judging by the bleached appearance it would seem that little nutrient value remains in the old stems. Horses can use at least part of the dry stems and seeds in summer, for the short period during which the seeds remain attached to the panicles.

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1/ See paper under this heading in Jour. Amer. Soc. Agronomy, December, 1939, by George Stewart and A. E. Young.

In Gem County the 1938 forage production on areas of several thousand acres was from 40 to 400 percent greater than in 1937. Production also varied widely from one area to another, both on different soil types and within the same soil type, probably owing largely to variations in soil depth and soil moisture.

Forage production on small plots bearing nearly pure stands of downy chess was 5 to 12 times as great in 1938 as on the same plots in 1937. Forage production from plots bearing mixed stands of perennial forage species and downy chess varied much less, and that from nearly straight stands of perennials still less. Remnant stands of perennial forages in moist years yielded approximately twice as much forage as did downy chess, and in years with a dry fall and a dry spring (1937) about 12 times as much. A smut epidemic on downy chess also reduced its production on the Arrowrock Addition to the Boise Forest almost to nothing for the 3 years of 1936-38.

These acute shortages in the yield of downy chess, which may come almost without warning, introduce such a large element of understanding into the feed supply program of stockmen that it is extremely hazardous for them to use this plant as a basis on which to establish grazing operations.

The high hazard of basing grazing management on downy chess, the difficulty and uncertainty known conditions under which perennial forage species may be re-established on ranges occupied by it, and its widespread and apparently increasing occurrence all point unmistakably to downy chess as constituting one of the major unsolved range problems of the Intermountain region.

#### Spring-Fall Ranges

Permanency of the Effects of the 1934 Drought. On sagebrush-grass ranges at the United States Sheep Experiment Station the effects of a single year of severe drought are by no means confined to that year and to the year following but may have a prolonged influence upon range cover and forage production. Records on 18 meter square quadrats, totally protected from grazing, indicate that where tuft-forming perennial grasses such as bluebunch wheatgrass (Agropyron spicatum), needle-and-thread (Stipa comata), Indian ricegrass (Oryzopsis hymenoides), and other associated species are the chief forage plants on a range area that effects of the drought may be discerned even 5 years after the drought year. Reasonably favorable climatic conditions have prevailed since 1934 on the upper Snake River plains.

As shown by a summary of basal area trends since 1932 it was 3 years following the drought before an upturn in the basal area of grasses became evident. These were fairly favorable years for plant production as judged by prevailing climatic conditions and from observation.

Annual weeds and seedlings, favored by the lesser density of perennial grasses and the resultant decreased competition for moisture, were very abundant and may have created the impression that drought effects were overcome in a single year, i.e., that the ranges were producing the most forage in years. Since very few of the seedlings of perennial grasses survived during these years, the increased basal area in 1938 and 1939 is as a whole a result of increased area of plants surviving the drought, and not of the establishment of new plants.

Perennial weeds appear to have received less prolonged injury from the drought than did the perennial grasses. However, since quadrat mapping methods have never been very satisfactory for perennial weeds, these records should be regarded with caution.

Summary of trend of average basal area and plant numbers per meter-square quadrat 1932 - 1939.

Species		1932	1933	1934	1935	1936	1937	1938	1939
Agropyron spicatum	Area (cm <sup>2</sup> )	295	321	187	181	178	190	202	223
	No.	41.4	57.6	65.1	58.1	61.3	58.2	60.9	56.7
Stipa comata	Area (cm <sup>2</sup> )	121	124	77	69	57	74	71	82
	No.	5.2	12.4	14.4	17.8	20.4	22.9	22.9	23.1
All grasses	Area (cm <sup>2</sup> )	559	570	338	337	305	352	364	414
	No.	76.3	117.4	117.6	124.9	126.3	124.6	138.2	128.5
Perennial weeds	Area (cm <sup>2</sup> )	18	138	78	121	89	138	92	99
	No.	42.6	44.8	26.4	48.2	42.9	45.8	47.6	45.7
Annual weeds and seedlings	No.	58.2	12.7	0.0	120.1	339.6	47.7	52.7	11.6

### Northern Rocky Mountain

General. Unusually fine but dry fall weather permitted field work nearly every day through November at Vigilante, Miles City, and Missoula. All members of the range staff have recently reported at Missoula for a session of compilation, analysis, and reports. An experiment in training was tried by detailing Collins and Holscher each to a ranger district on the Custer National Forest for 15 days in November. The idea was to have the trainee assist in the day-by-day tasks of the ranger and to gain the best insight possible in administrative work with grazing being given some emphasis but not exclusive attention. It was also hoped that the detail would be mutually helpful and aid in developing a closer tie between research and administrative efforts and problems.

Collins and Holscher have submitted brief reports on their detail and are well pleased with the experience and what they learned. They believed they were really helpful rather than otherwise to the rangers concerned.

### Pacific Northwest

#### Summer Range

Tent Caterpillar Infestation of Bitterbrush. At the request of the Deschutes Forest, the Bureau of Entomology and Plant Quarantine in cooperation with the Experiment Station set up a project in 1939 to investigate a serious defoliation of bitterbrush caused by the Great Basin tent caterpillar (Malacosoma fragilis). Bitterbrush is an important forage plant on the forest, and its defoliation for even a portion of one year raises serious problems in the management of the range.

The present outbreak, located chiefly on the Fort Rock Ranger District, started in 1937 and reached epidemic proportions in 1938. Serious defoliation occurred again in this area in 1939.

In May and June of this year the bitterbrush on many portions of the area had been so heavily defoliated that much of it appeared to be dead. Following the feeding period of the caterpillars (they spin their cocoons and become dormant in July, then emerge in August to lay eggs which hatch the following spring), the bitterbrush sent out new leaves and appeared to recover somewhat from the defoliation. Many plants on lightly defoliated areas appeared nearly normal in September, while others, and most plants on areas of heavy defoliation, showed only partial recovery. Following this recovery, the plants were subjected to a second disturbance by sheep which grazed the area, subsisting largely on the bitterbrush.

The objectives of the cooperative project are: (1) to obtain data on the life history of the Great Basin tent caterpillar; (2) to determine the extent of recovery and mortality of the bitterbrush following defoliation by the caterpillars; and (3) to determine the combined effects of defoliation by caterpillars and a second partial defoliation by grazing.

As a sidelight on the study, it is interesting to note where the tent caterpillars spin their cocoons. Of 386 cocoons collected for study, 43 percent were found inside tents on the bitterbrush plants, 32 percent in stools of Idaho fescue, and 25 percent in pine stumps and slashing left on the ground after the logging operation.

## Rocky Mountain

### Noxious Plant Control

Orange Sneezeweed in Colorado. When investigation was started in 1938 on the orange sneezeweed 1/ problem, it was recognized that more information was needed on the economic status of the plant in this region. Not having sufficient funds or time to make a regional survey, the experiment station submitted a questionnaire to each ranger district of the region. This questionnaire was designed to obtain specific information on the distribution of sneezeweed, the losses it causes, management methods used to decrease losses and other information pertaining to its economic importance. The forms were sent out through the Regional Office in April 1939 with the suggestion that the rangers become familiar with the plant, and questions to be answered; then to make the necessary observations and notes during the summer grazing season and complete the forms afterwards.

The reports were well prepared and furnish pertinent information which could not have been obtained by other means, and which may well form the basis of a regional control program. The following summary is based entirely on answers sent in by the rangers. It agrees in most respects with the results of research during the summers of 1938 and 1939, and in addition it supplements our knowledge of distribution and losses.

Areas infested. Sneezeweed occurs in 52 districts within 13 of the 21 national forests of Region 2. All of the infested forests are in Colorado; the Roosevelt is the only Colorado national forest that is not infested. Maps prepared on each district show the area infested by each of four degrees: heavy, moderately heavy, light, and scattered.

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1/ Hereafter this plant is called sneezeweed, for sake of brevity.

There are 1,520,418 acres in Colorado infested with the plant. Sneezeweed is one of the dominant weeds on about 300,000 acres. The infestation per national forest ranged from 200 acres on the Cochetopa to 429,000 acres on the White River National Forest.

The heaviest stands of sneezeweed are about evenly divided between cattle allotments and sheep allotments, and such stands are found most often on heavily grazed areas. The plant occurs most abundantly in dry meadows, parks, aspen, and open or cut-over spruce types. The maximum elevational range of heavy stands is from 7000 to 12,500 feet, the mean range from 8,224 to 10,300 feet and the optimum or mean elevation at 9,400 feet.

Losses caused by sneezeweed. There are 304 bands containing about 290,000 sheep that graze infested allotments in Colorado. The reported death losses from sneezeweed poisoning during the past five years have averaged about 3000 head or approximately one percent. The estimates of unreported losses bring the annual average to 4000 head. This represents an annual loss to wool growers of between \$25,000 and \$30,000. Indirect losses such as loss in weight and condition of lambs probably equals death losses.

Causes for the increase of sneezeweed. The general opinion of administrative officers is that grazing has been the main factor in the comparatively recent increase of the weed--particularly overgrazing of parks and local areas. Selective grazing has favored sneezeweed while grasses and other weeds were destroyed. The plant's aggressiveness and prolific reproduction by seeds and offshoots, drought conditions and the disturbance of the soil by pocket gophers are all important factors in the rapid spread of the plant.

How may sneezeweed be controlled. Many methods for the control of sneezeweed were suggested. The most important of these are: grubbing isolated patches and small infestations, reseeding with Kentucky bluegrass, reducing the rate of stocking on infested allotments, better management of sheep, and control of pocket gophers.

The symptoms of poisoning. The symptoms of sneezeweed poisoning have been well described, but it was thought that those familiar with numerous cases of poisoning might describe other symptoms. The symptoms most frequently noted are:

1. Chronic vomiting or attempts to vomit. This is accompanied by general nausea, frothing, coughing, sneezing, depression and increased activity.
2. Weakness and poor control of legs.
3. Stiffness or lameness and partial paralysis, particularly in lambs.

4. Loss of appetite, loss of weight and poor condition are noted in the later stages of poisoning.

When do most death losses occur. Most losses come in the fall after the first heavy frost which usually kills most herbaceous plants, while sneezeweed remains green and produces new growth. Losses are also great in late summer when the best forage plants are dry, tough, or closely grazed; in spring before other plants have made a good start; when sheep are bedded on or near infested areas; and when hungry sheep are allowed to graze infestation.

How may losses be reduced. It is encouraging to note that a few progressive permittees are able to use sneezeweed-infested range with comparatively light losses. Their answer appears to be proper management, and most suggestions on reduction of losses dealt with management. These are:

1. Shorten the grazing season or remove sheep from infested range after the first killing frost.
2. Reduce the rate of stocking so that there is an ample supply of good forage at all times. This may be accomplished by reduction in numbers, shortening the season, or providing larger allotments.
3. Avoid infested areas when the sheep are hungry, thirsty, or in poor condition. Keep off such areas in the spring until the forage plants have made a good start.
4. Grazing infested areas lightly.
5. Move sheep to non-infested range when symptoms of poisoning first appear. Graze infested and non-infested areas in rotation.
6. Practice better management: herd openly and quietly; use the bedding-out system, do not bed near or on patches of sneezeweed.
7. Truck sheep over infested driveways.
8. Sell all ewes that have been poisoned, and for replacements select ewe lambs that have not been poisoned.

## Southwestern

### Noxious Plant Control

Burroweed. Studies on the control of burroweed (Aplopappus fruticosus), a noxious range weed of southeastern Arizona, carried

on at the Santa Rita Experimental Range (see Monthly Reports for June and October, 1938, for further details of study) were concerned principally in finding an effective and practical method of killing burrowweed. Accordingly, 208 plots (.02 acre), of which 104 are located at Station No. 130 and the remainder at Station No. 131, were subjected to 25 different mechanical and chemical treatments at intervals of 3 months starting in May 1938. The data presented in the accompanying table are based on observations made in June 1939. The figures on percentage kill were computed from actual counts of burrowweed on the plots, both before and after treatment. A 90-percent kill or better is considered as being effective, since it was found that no matter how effective a method might be it was necessary to repeat the treatment in order to eradicate plants which were missed in the initial application.

Perusal of the contents of this table yields some interesting information on the various methods of eradicating burrowweed. Except for the spring drought period, there was little or no change in the population of live burrowweed plants on the check or untreated plots. All treatments were more effective in May than at any other period of the year, which was probably due to the low vitality of the burrowweed plants at this time. Variations in the percentage kill within similar treatments are likely due to such factors as variation in plant vigor, plant competition, soil texture, soil moisture, variation in amount of chemical or degree of mechanical injury per plant, and failure to treat all plants similarly and completely (the human error). Death of untreated plants may be due to a single causative agent or more than likely to a combination of such factors as drought, insect attack, competition, old age, parasites, grazing, etc.

Grubbing was most effective in spring and early summer, not because of physiological differences but rather because of ease in spotting the plants, or what in zoological terms might be called "protective coloration." Under field conditions the green burrowweed blends with the other vegetation during the summer and it turns brown or yellow along with the other vegetation during the winter. At other times of the year burrowweed plants are easy to locate as they are green whereas other vegetation is usually brown.

Mowing was effective only in the spring season of the year. In treatments to be applied in the future it will be tried in combination with other methods of eradication.

Burning was most effective in the spring and largely ineffective during the later fall and winter.

In concentrations of 5 percent and above, sulphuric acid always resulted in defoliation of burrowweed, and on the plots treated in May it was fairly effective; however, at other seasons there was little or no lethal effect. In fact, the burrowweed population apparently increased



on most plots. Unless used in combination with some other treatment, such as mowing, the use of sulphuric acid will be discontinued.

The chlorate sprays (Atlacide and sodium chlorate) were most effective on plots treated in May, the typically dry period of the year, which was contrary to the results obtained with snakeweed. There appeared to be little difference between the two chemicals in effectiveness, although sodium chlorate is reputed to be the best herbicide. Further trials with these chemicals will be carried on during the 1940 field season.

Various heterogeneous mixtures of Colemanite or borate ore with sodium chlorate are apparently less effective and more expensive than chlorate sprays, although there is little or no fire hazard involved in their use.

Kerosene was ineffective at all times of the year. Stove oil and diesel oil yielded somewhat erratic results. It is possible that either one or the other might be used on regrowth of burroweed following mowing in the spring with effective results.

Burroweed plants sprayed with stove oil and followed 10 days later by igniting the plants was similar in effect to burning with a flame gun. However, this treatment was considerably more expensive as two distinct operations were involved.

The effects of various mechanical and chemical treatments on  
burroweed (Aplopappus fruticosus)

Treatment	Station No. 130				Station No. 131			
	Time of treatment				Time of treatment			
	May	Aug.	Nov.	Feb.1939	May	Aug.	Nov.	Feb.1939
	Pct. plants killed	Pct. plants killed	Pct. plants killed	Pct. plants killed	Pct. plants killed	Pct. plants killed	Pct. plants killed	Pct. plants killed
None (check)	27.0	4.2	#6.8	0.9	47.7	#9.4	#14.1	#4.6
Grubbing	100.0	90.0	79.7	89.9	100.0	65.8	71.1	41.2
Mowing	93.2	24.6	#2.5	22.0	97.3	10.1	#5.5	#4.5
Burning	100.0	87.0	44.6	49.0	100.0	89.0	33.3	52.1
2.5% H <sub>2</sub> SO <sub>4</sub> *	57.5	#3.3	#2.8	#2.1	37.7	#4.9	#23.2	#23.8
5.0% "	83.2	#13.6	#3.2	#20.2	40.0	23.0	#11.6	#20.1
7.5% "	92.2	#1.6	#13.3	#0.3	53.6	1.8	#14.5	10.2
10.0% "	98.7	#5.6	#12.6	21.1	67.2	2.2	2.3	#0.9
5.0% Atlacide	84.3	24.8	#4.5	2.3	71.8	33.0	24.3	29.0
10.0% "	99.0	75.9	30.5	29.9	64.1	7.4	38.6	3.2
15.0% "	100.0	41.7	74.6	86.0	89.2	70.9	72.3	34.7
20.0% "	100.0	71.0	64.0	90.8	90.9	62.3	70.4	53.4
25.0% "	100.0	70.3	83.8	80.2	98.5	64.0	88.0	63.0
5.0% NaClO <sub>3</sub>	73.4	49.6	31.1	31.9	53.1	17.1	45.2	25.3
10.0% "	99.1	83.3	52.2	36.0	76.9	26.0	86.0	53.7
15.0% "	98.5	45.9	81.5	92.6	82.3	67.6	88.7	67.1
20.0% "	100.0	53.9	86.1	95.1	59.0	88.8	98.2	80.8
25.0% "	97.6	80.7	92.2	97.1	94.6	88.0	99.0	85.3
Borate-NaClO <sub>3</sub> 5:1**	97.3	84.6	56.7	35.1	87.7	63.3	75.8	24.8
" " 7:1	91.2	41.9	31.1	30.0	81.9	61.7	64.4	#11.6
" " 10:1	81.2	48.3	54.5	49.0	87.3	59.6	10.9	15.8
" " 20:1	82.6	23.3	14.3	21.7	82.2	32.9	59.8	5.9
Kerosene	73.3	18.5	20.2	2.0	52.9	26.4	#16.0	#8.2
Stove oil	98.7	#6.8	25.8	22.1	44.4	12.9	#7.6	6.4
" " followed by burning	100.0	77.9	69.9	48.6	100.0	93.0	56.5	43.1
Diesel oil	98.0	62.4	27.8	25.9	82.8	2.8	4.4	11.9

\*Concentration expressed as percentage by dry weight.

\*\*Parts borate ore to parts sodium chlorate by dry weight applied as a dust; other chemicals were applied as aqueous solutions or full strength liquids.

#Sign indicates no kill but percentage increase.

Goat Range Study. After a lapse of 20 years, studies have been resumed on the problems dealing with the management of range goats in the Southwest. About a year ago, the Arizona Mohair Growers Association formally requested that the University of Arizona, the Soil Conservation Service, and the Forest Service cooperate with them in a study to determine, through sound experimental evidence, the true effects of goat grazing upon the brush lands of central Arizona.

Working jointly, under a cooperative agreement, these three agencies started preliminary work last April on two ranches near Skull Valley and Kirkland, Arizona. So far the study has been confined mainly to the comparison of the vegetation on range grazed by goats and that within a series of representative fenced enclosures. While the study is of necessity limited in scope, it promises to throw considerable light on certain problems that have arisen regarding the utilization by goats and grazing capacity of browse type ranges.

#### Utilization Standards

Forage Production and Utilization. Late in the spring of 1938 three panel enclosures were set out on the Santa Rita Experimental Range for demonstration purposes in connection with the Coronado Ranger's Meeting. The prime objective of these demonstration enclosures were: (1) To determine what part of the total volume of forage produced was left on the ground when the plots were clipped to represent proper use; (2) to illustrate, by clipping, what constituted a proper degree of use for several of the most common grasses found on semidesert ranges.

The demonstration enclosures were 20 x 40 feet, and within each one there were established three strip plots (each 5 x 35 feet) paralleling each other. One of these strips was first clipped to what was considered proper use and the forage put in paper bags and kept separate as representing available forage under proper use of the range. The same strip was then clipped down to within 1/2 inch or less of the ground. The material from this latter clipping represented the plant reserves or amount of vegetative growth that should be left on the ground when the range was properly grazed. After being thoroughly air-dried, the forage from these two clippings was weighed and furnished data for the first objective above. A second strip in each enclosure was clipped to represent proper use and left in that condition, thus meeting the second objective stated above. The third strip in each enclosure was not clipped but used as a check against the closely and properly clipped strips. The clipping was repeated in 1939, thus furnishing results for two years.

The following table shows, for each of the years 1938 and 1939, the total yields of forage from the overused plots broken down into

percentages of available forage and the reserve that should be left on the ground. The final pair of columns show the average obtained for the two years.

Grasses	Total yield		Available forage		Reserve		Average for 2 years	
	1938	1939	1938	1939	1938	1939	Avail-able	Reserve
	G	G	Percent	Percent	Percent	Percent	Percent	Percent
Slender grama	2,120	1,329	68	66	32	34	68	32
Poverty three-awn	609	386	73	72	27	28	73	27
Side-oats grama	293	128	71	63	29	37	69	31
Black grama	842	404	62	48	38	52	57	43
Hairy grama	54	46	77	72	23	28	75	25
Rothrock grama	560	137	90	60	10	40	84	16
Sprangletop	-	6	-	75	-	25	75	25
Arizona cottongrass	200	24	69	54	31	46	67	33
Texas-timothy	20	96	64	62	36	38	62	38

The variation in amount of reserve forage for the different grasses was quite noticeable, varying on the average from a minimum of 16 percent of the total yield in the case of Rothrock grama to a maximum of 43 percent in the case of black grama. Generally speaking, it would seem that the grasses which produce abundant leaf growth show a proportionately smaller amount of the total volume in reserve. Perhaps the most interesting results lie in the comparison of the percentages of reserve forage in each of the years 1938 and 1939, the former being a rather high producing year (see table, first column) and the latter producing considerably less growth. Without exception, the reserve forage in 1939 formed a higher percentage of the total than was the case in 1938. Rothrock grama showed the widest variation in this respect with 10 percent total yield left as reserve in 1938 and 40 percent in 1939. Slender grama, poverty three-awn, and Texas-timothy made about the same growth in both years, and it is significant that the percentage of the reserve for these three grasses is quite close together in both years. These variations in percentage of reserve forage appear to present much the same problem as has been encountered in taking the percent of height growth each year and the desirability of basing

utilization estimates on the stubble height remaining rather than on the percent of either height growth or volume of forage that should be left on the ground at the end of the grazing year.

### General

Southern Arizona Rainfall and Range Conditions. In southeastern Arizona rains during the months of October and November have been spotted and somewhat below average over most of the section. Late in October amounts varying from .25 to .75 inch covered most of the region and during the latter days of November much the same condition was repeated. Little immediate good will result, except in a few localities where there may be a small amount of early winter weed growth. Where alfileria is common, ranchers report that it is getting a much better start than usual, though it can hardly be expected to furnish much if any feed until late winter or spring. Feed is already short in most sections, and even along the Mexican Border, where conditions were better than for several years, cattlemen are not too optimistic over the outlook. The poor outlook may have its compensation in the long run, as many cattlemen are culling their breeding herds heavily and early sales indicate that more cows will move off the ranges than for a number of years past. Coupled with this movement there seems to be a definitely larger number of cattlemen who are planning on keeping their herds cut down until their ranges show improvement. There will, of course, be some who will find it difficult to resist the temptation to restock with the first good year that comes along; however, there are many indications of a growing respect for the fact that drought years are in the majority and that the occasional good years do not repair the damage that is done through continuous overuse of the range.

Rainfall and range conditions on the Santa Rita Experimental Range as a whole have been considerably below average during the current year. The spring season was very dry and was followed by subnormal rainfall over the major portion of the range. The north two-thirds of Pastures 5, 6B, and 15, as well as a small strip along the west side of 12B, received from 15 to 25 percent above the average summer precipitation, while over the balance of the range rainfall was 15 to 25 percent below average. As a result of these conditions, the forage crop was reasonably good where precipitation was above average and very poor over most of the remaining area. A narrow strip along the extreme eastern side of the range produced excellent growth despite the fact that rainfall was slightly below average in that section.

Range water. The range water situation has been temporarily improved; though, without exceptional winter precipitation, conditions will be as serious next spring as they were last year, as the ground water supply has not been replenished for several years. Part of the

water troubles may be alleviated by an ever growing demand for water development under the AAA range program. But permanent improvement will be slow as most of the AAA development is in the form of temporary surface tanks rather than permanent waters, most of which are too expensive in the semidesert region.

With the completion of two new wells on Parker's range and the development of Shamrod Spring on Ruelas' range, the permanent water situation on the Santa Rita has been improved to the point where little further trouble should be experienced, even in severe drought years. During the past summer the permanent watering places were augmented by temporary water in 13 out of 16 surface tanks on the range. In 5 of these tanks water is still available and should last until well into the spring.

Condition of cattle. Nearly everywhere cattle are in definitely subnormal condition for this season of the year. A narrow strip of country along the Mexican Border, from Sasabo to Douglas, furnishes the only exception. Generally speaking, breeding cows never got fat all summer and in some places are almost poor now without having experienced any winter weather up to date. As a result of this, the majority of calves marketed this fall were in poorer flesh than usual. Even yearlings failed to put on the gains usually looked for.

Breeding cows on the Santa Rita were somewhat below normal during the spring and failed to reach their usual good condition at any time during the summer. As a result of this, calves got off to a poor start and failed to make normal growth by the time the fall market period arrived. Going into the winter, cows are slightly below average.

Marketing. Despite generally lighter weights the net receipts per head have been higher than for several years due to better than average prices. Calf prices have ranged from 7 cents up to as high as  $9\frac{1}{2}$  cents. The lower prices were largely the result of contracts made in the spring, though in a few cases it was quality of the product offered that governed. The majority of sales made during the latter part of the summer and later were at the higher figures, few going below 8 cents. Yearling steers ranged from  $6\frac{1}{4}$  cents to as high as 9 cents, the majority going around  $7\frac{1}{2}$  cents and 8 cents. Dry cows brought 4 cents to  $5\frac{1}{2}$  cents, quality and condition being an important consideration. Young cows for breeding purposes ranged from \$40 to as high as \$55 per head, age and quality being the prime requisites for the higher prices.

Calves on the Santa Rita averaged 351 pounds, or some 30 pounds lighter than usual, while yearlings weighed 547 pounds or around 30 pounds below average. Prices received varied from  $7\frac{1}{4}$  cents to  $8\frac{1}{2}$  cents for heifer calves,  $7\frac{1}{2}$  cents to  $9\frac{1}{2}$  cents for steer calves, and

7½ cents for yearlings. The low prices for part of the calves were due to the fact that one of the cooperators contracted his big calves last spring as is his usual practice. The light calves were not contracted until late in the summer and brought him 8½ cents and 9½ cents per pound for heifer and steer calves respectively.

While there was a rather wide spread in prices in all localities, some sections seemed to command generally higher prices than others. Cochise County, especially around Douglas, ranked well up toward the top in this respect. One bunch, of around a thousand head of calves, in that section averaged better than 400 pounds and grossed their owners around \$38 per head.

Jornada Field Day. The Jornada Field Day was held October 23 as a continuation of the annual "Ranch Day" as presented by the New Mexico State College Animal Husbandry Ranch last year. This event is scheduled to be an annual affair with the Forest Service and the Animal Husbandry department of the college cooperating and each accepting the major portion of the program in alternate years. Nearly 250 attended the demonstration including stockmen from Arizona, Texas, and New Mexico. Some Government officials from Colorado and Utah were present.

The program began on the State College ranch where J. O. Bridges explained and demonstrated some results of range reseeding trials on two plots. He discussed the various methods used in reseeding work such as preparation of seed beds, contours, clearing, and disking. The advantages of protection from rodents and grazing were also brought out. It was demonstrated that seeds planted to a depth of about 1½ inches produced plants which withstood the dry windy months better than those planted at more shallow depths. The most striking part of the demonstration was the high percentage of survival of the African lovegrass, one of the more promising exotic forage plants.

The next stop was at Camp Well on the College Ranch where J. H. Knox, head of the Department of Animal Husbandry of the State College, discussed beef production on black grama grass ranges. Mr. Knox effectively demonstrated the advantages of conservative range use by exhibiting a small bunch of cows which averaged over 1,000 pounds in weight with their calves which weighed nearly 450 pounds each. Data were presented which showed that with an average rate of stocking of around 9 or 10 animal units per section a greatly increased production per cow due to number and weight of calves could be expected. Other advantages shown for conservative management were: increased calf crops (97 percent - 3-year average), decreased death losses, smaller investment because of herd reduction, increased sale value of calves, steers, old bulls, and cull cows, and reduced feed and labor costs.

The third stop was near the Jornada boundary where F. N. Ares explained the Jornada grazing management plan.

At the fourth stop K. W. Parker discussed the control of snake-weed. The various methods of control and the results from each separate treatment were given. These treatments consisted of grubbing, mowing, and spraying with various chemicals and oils. Some of the plots were also reseeded to sand dropseed grass. The most effective and cheapest method of mechanical control to date was found to be by grubbing. A most interesting point brought out was the possibility of controlling the weed by insect enemies.

The next stop was for the purpose of examining an electrical one-fire fence in operation near headquarters. Its possibilities in range control, segregation of poison plant areas, and other uses were discussed by Ares. Three such fences in use on the Jornada have proven that they have possibilities for holding livestock on tobosa grass for a short time to obtain full use while at the same time giving protection to the surrounding black grama. Electric fences have also been used to keep cattle temporarily out of poison plant areas during periods of high danger.

The device is effective for range use only when the soil is fairly damp following showers. If cattle are trained to respect the "hot" wire during damp weather, they usually keep away from it later even though the shocking power may be greatly reduced.

At this same stop a stack of nearly 4 tons of tobosa hay cut on a nearby plot attracted much attention and comment from the stockmen. A chart showing chemical feed analysis of the grass cut at varying stages of maturity indicated that the best hay was produced if the grass were cut in the early stages of maturity.

The next stop was for lunch at the Jornada headquarters with barbecue furnished by the Cooperator, Mr. B. A. Christmas. Several short talks were given by representatives of the various Government bureaus, officials from the State College, and stockmen. Mr. Christmas stated that the management policies followed on the Jornada coincided exactly with the methods of ranching which he had successfully followed for the past 20 years on his other ranches.

A demonstration at headquarters which attracted much attention was the exhibit showing treatment of fence posts with preservative by the tire tube method. Several posts from timber species, commonly considered as unfit for fence posts such as pinon and ponderosa pine, cottonwood, and aspen, were treated with zinc chloride which readily flowed through the green timber on exhibition impregnating the sapwood with the preservative.

The Soil Conservation Service had a very attractive exhibit of photographs showing beneficial results of water spreading and contouring. The Forest Service display of poisonous and other southwestern plants also attracted much attention from the crowd.



After lunch a stop was made in pasture 10 where the results of 24 years' management of black grama were given. Actual stocking and capacity figures were given to show that the range under continued proper use had maintained itself. The stocking rate of the pasture for the 24-year period was shown to be 12 head average per section per year, and this number was recommended as the safest rate for this grass over a long period. Two black grama utilization plots clipped to represent proper and over use had been prepared previously and then were used to show how these degrees of use appeared on the ground.

The next stop was made near the south boundary where K. A. Valentine explained the experimental set-up and nature of the studies being carried on for the purpose of developing means of improving creosotebush ranges. Stockmen in this particular locality, where much range is occupied by this worthless shrub, were very much impressed with the experimental work along this line, and it is believed that they will closely follow the course of future work and results.

W. G. McGinnies closed the program with a discussion of range deterioration and the possibility of improvement. Standing on a depleted range area, which as proven by photographs of the area supported a good stand of black grama 20 years ago, he brought home to the crowd the changes which had occurred because of the wrong kind of grazing use of the area. He pointed out the vicious circle set up when the perennial grasses were killed out and the soil, through erosion, lost much of its value and ability to produce the humus-forming vegetation which would restore the original quality. He also summarized the day's activities and expressed the hope that continued progress could be made in the solution of the major range problems through the cooperative efforts of the various research agencies working closely with the stockmen.

#### COOPERATING BUREAU PROJECTS

##### ENTOMOLOGY

(In cooperation with the Bureau of Entomology and Plant Quarantine)

##### Northeastern

H. A. Bess of the New Haven, Connecticut, laboratory reports as follows on an examination of logs sprayed by various chemicals last spring by B. H. Wilford of the Asheville, N. C. station: "Field tests were made during the past summer at the Harvard Forest, Petersham,

Mass., to determine whether certain chemical sprays would be effective against insects which cause damage to logs in dry storage. Thirty-three decks of approximately 50 logs each were used in the study, and over a dozen different sprays were applied. Recently an examination was made of the logs and it was found that none of the sprays had proved to be effective, especially against barkbeetles, which were abundant in all decks. Sawyers, however, were more numerous in the unsprayed check decks than in the sprayed ones."

H. R. Dodge, temporary assistant during the summer of 1939, of the New Haven, Conn. laboratory, reports as follows on some of his observations of insect attack in hurricane-felled white pine in Massachusetts: "During July, August, and part of September considerable time was spent in examining hurricane-felled white pine in Massachusetts to determine the extent and nature of insect attack. Observations were confined principally to this tree species for it constituted probably at least 90 percent of the merchantable timber which was blown down in this area. The examination was primarily of logs which had been purchased by the Northeastern Timber Salvage Administration of the U. S. Forest Service and held in dry sites preparatory to sawing. In the latter months, however, attention was given to logs in ponds, and the logged and unlogged blowdown areas in the woods. Insect conditions did not seem serious in July, and in lumber sawn prior to August 1 there was very little damage due to Monochamus, ambrosia beetles, or blue stain. In late August there was an appreciable increase of infestation by bark beetles and Monochamus, and at a few sites damage by the latter was commonly encountered in the sawn lumber. The heaviest infestation by ambrosia beetles noted in July was 1.42 percent of the logs at one site, while in August the percentage has increased to 5.71. Similar figures for Monochamus were 2.61 percent in July and 10.51 percent in August. It is probably that in the case of Monochamus many infested logs were overlooked in the July examination because the larvae were too small to push out borings. Buprestid larvae were not uncommon, but their damage was considered slight.

"There was evidence from observations on Monochamus that the insects in some cases had infested the logs in the woods prior to removal to dry sites, while in other cases they had infested the logs at the site by flight from adjacent woodlands. As would be expected, the larger the volume of logs the more dilute was the insect population. The Moulton field at West Concord was remarkably free from insects, and this was probably due to the fact that the logs were all removed from the woods during the dormant season, and the site was well removed from pine woodlands which might have served as centers of infestation.

"Floating logs were in good condition and free from stain, although in some logs bark beetles had successfully reproduced under the bark of the emersed surfaces (top sides). In the woods some wind-thrown trees were still in good condition a year after the storm, but

most timber of merchantable size had died due to insect attack, sunscald, drought, or a combination of these factors.

"The insects attacking green trees were largely Ips calligraphus and Ips pini, and these may be expected to kill some standing timber adjacent to windthrown areas and mills next year. Orthotomicus caelatus was the most common bark beetle found in the logs. Gnathotrichus materiarius and Xyleborus sp. were the ambrosia beetles most frequently encountered. Buprestid larvae were common, but adults were rarely seen, so it is concluded that they had passed the peak of adult activity before observations began."

### Southern

On October 4, with Mr. Hatfield of the Monsanto Chemical Works, the soil poison and wood preservative tests at Marrero, La., were inspected; several chemicals appear effective. Similar tests of the Hercules Powder Company were also inspected at this time. Progress reports were filed on the results of these inspections.

On October 6-7 Johnston assisted Hatfield in the inspection of the soil poison tests of the Monsanto Chemical Works and Sharples Company at Saucier, Miss., and a progress report was filed; several chemicals show promise.

A survey of the different types of metal termite shields on buildings at New Orleans and their effectiveness was made on October 12.

On October 17 Johnston inspected the medicated tree sections under test at Saucier, Miss., and submitted a report.

Johnston reports that at Saucier, Miss., Platypus compositus requires 7 to 8 weeks and Xyleborus affinis about 7 weeks to complete their life cycles. Photographs of all stages of P. compositus have been taken.

Christian at Tallulah, La., has discovered three additional chemicals that are effective in protecting green lumber from attack by ambrosia beetles. Lumber dipped in a solution of borax as high as 7 percent is being infested by Lyctus planicollis, while as low as 2 percent gives protection against parallelipipedus.

PATHOLOGY  
(In Cooperation with the Bureau of Plant Industry)

Appalachian

New Disease of Sugar Maple. There has been a heavy mortality of sugar maple from 8 inches d.b.h. upward, in a part of the Big Ivy Working Circle of the Pisgah National Forest. About 80 trees, mostly in one cove, have died in the past two or three years. The first external symptom is a thinning of the foliage, sometimes only one side of the crown being involved at first. Apparently within a year or so after this crown thinning, the tree dies. Cuttings were made into the trunks of trees on which the foliage had been thinned, and the outer sapwood was found to be water-soaked with dark finger-like projections extending toward and in some cases to the cambium. The pH of this zone is about 8.5, compared to 5.5 for normal sapwood. Isolations gave mostly negative results with occasional bacteria. Green streaks frequently accompanied the "soak". Isolations from them yielded no organisms. A large part of the cross-section of roots and lower portions of stems were occupied by a blue-stain fungus, Endoconidiophora coarulescens, although many of the trees were still alive. The roots seem to die before the crowns. This disease will be studied intensively next spring, after the sugar maple leafs out.

Plantation Examinations. The survey of older southern pine plantations was extended into South Carolina, where eight plantings were examined. The two longleaf plantings were free from serious diseases. The two loblolly stands examined were in good condition, with only an occasional tree with a rust canker on the trunk. All of the four slash pine plantings had abundant rust cankers and two were cankered seriously. The percentages of trees with trunk cankers for the four slash pine plantings were 7, 14, 31, and 40. Plantations with 31 and 40 percent of the stems cankered were less than an acre in size. One had abundant rust-susceptible oak in and around it and the other very little oak nearby.

Southern

Native canker forming rusts. The annual survey to determine the amount of rust infection in southern pine nurseries was completed. A total of fifteen nurseries were visited and the beds of slash and loblolly pine seedlings systematically examined to determine the percentage of rust infection. It was found that some nurseries had less infection than last year and that others had about the same amount while a few had slightly more. It was estimated that over two million slash pine seedlings and over two hundred thousand loblolly pine seedlings will be lost this year because of rust infection in the nursery.

There will probably be some loss in longleaf stock also as a result of rust infection but information on this species will not be available until the plants have been lifted.

Spray programs were followed in several nurseries this season and the results obtained indicate that properly timed spray applications early in the season may provide a practical method of reducing losses due to rust infection. It was again evident that there was a smaller percentage of rust infection in late sown beds than in beds of the same species sown at an earlier date in the same nursery. At one nursery an oak free zone of fifteen hundred feet about the nursery did not sufficiently protect the young seedlings from rust infection to establish it as a satisfactory control measure.

The little-leaf disease of pines. The little-leaf disease which is prevalent on shortleaf pines has been found in Harris Co., Ga., and in the following counties in Ala. -- Autauga, Bibb, Clay, Chilton, Coosa, Chambers, Dallas, Elmore, Fayette, Jefferson, Lawrence, Perry, Randolph, Shelby, Tallapoosa, Tuscaloosa, Winston, and Walker. Laboratory studies have been made of fungi from diseased roots but it has not been possible to identify any of the organisms as pathogens.

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